(3)

DEVELOPMENT of a PREDICTIVE MODEL to ASSESS the EFFECTS of EXTENDED SEASON NAVIGATION on GREAT LAKES CONNECTING WATERS

USER'S MANUAL

Prediction of Vessel Impacts in a Confined Waterway

Michigan Technologial University
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The object of this study was to develop a method for forecasting the physical effects of the passage of commercial vessels through Great Lakes connecting waters during that period of time when traffic is normally at a minimum due to a more or less continuous ice cover. The physical impacts examined were sediment translocation, water quality effects, direct damage to existing structures, and changes in the gross hydraulic regime. Also associated with the User's Manual but bound separately are; Development of a Predictive Model to Assess the Effects of Extended Season Navigation on Great Lakes Connecting Waters, Final Report; Appendix A, Site and Soil Conditions; Appendix B, Observed Vessel Induced Water Level Drawdowns; and Appendix C, Observed Ice Thicknesses and Water Turbidities.

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DEVELOPMENT OF A PREDICTIVE MODEL TO ASSESS THE EFFECTS OF EXTENDED SEASON NAVIGATION ON GREAT LAKES CONNECTING WATERS

USER'S MANUAL

PREDICTION OF VESSEL IMPACTS IN A CONFINED WATERWAY

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October 17, 1986

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INTRODUCTION

The program "Prediction of Vessel Impacts in a Confined Waterway" was developed to allow the calculation of probable damage estimates involved with the passage of large commercial vessels through restricted waterways. During the development of the program, several subroutines were programmed to allow for use and storage of field data. All of these routines have been included in the package to make the program more useful. These subroutines include data input and storage, data file correction and update, and printout of data.

This manual has been designed to assist in the use of the accompanying PC program. Each of the routines included in the package is described in detail and each prompt that appears on the screen as the routines are used is included.

The components of the program have been broken into five separate subroutines that have been stored on the accompanying floppy disk. This disk also includes IBM DOS version 2.10, which was supplied by the sponsor. The program will load automatically by simply booting the system. This setup can be easily changed by taking the various routines off of the disk containing DOS 2.10 and loading them with other compatible versions of DOS.

The program is written in BASIC to allow for ease in performing any desired changes. The names of the five separately loadable programs are BEGIN, BEGIN.TWO, ONE.SUB, TWO.SUB and THREE.SUB. Flow diagram for each program is shown with each program listing.

When the system is booted, the PC will automatically load the small routine called BEGIN. The first screen to appear will be the program name. This monitor will clear itself after about 5 seconds and display the names of the authors and contracting officers. Press any key to move into the program. The following menu appears on the screen at this point:

MAIN PROGRAM OPTIONS

****

0 END PROGRAM EXECUTION - RETURN TO DOS

1 INPUT AND STORE FIELD DATA
GOTO TO PRINTER AND/OR PLOTTER

2 PERFORM CALCULATIONS

INPUT OPTION?

The first user option shown on the menu, OPTION 0, will return the PC to the ready mode in DOS. If this option is desired, simply type "0" followed by the enter key and the "A>" prompt will appear on the screen. The PC is now ready to accept any DOS commands or to end the session.

The user can select Option 1, INPUT AND STORE FIELD DATA GOTO TO PRINTER AND/OR PLOTTER, by typing "1" followed by the enter key. The computer will read a subroutine off of the disk and load it into memory. The disk must be left in the drive when reading option routines from the disk. The program that is loaded at this point is TWO.SUB.

TWO.SUB contains all of the programs for field data input and printout. The first thing to appear on the screen is a menu containing options available to manipulate data. To select a path of interest, again type an option number and press the enter key. Each subroutine will have brief explanation of its use displayed on the screen before any prompts for information are displayed. (See page 6 for an explanation of the use of Option 1 of the main program menu).

The printing routines are designed for use on a Okidata 93 on 8 1/2 x 11 paper. The plotting is set up for a Hewlett Packard 7470A Plotter.

There are other printing and plotting options throughout the program, and they also use the same hardware. A full printout of each subroutine, including TWO. SUB can be found at the end of this manual in BASIC. This allows for hardware changes to be made easily.

Option 2 of the main program menu is the calculations mode of the package. It contains two subroutines called ONE.SUB and THREE.SUB. If Option 2 is selected, the PC automatically loads ONE.SUB. The program disk must again be left in the drive when the option is entered. A detailed explanation of Option 2 can be found on page 33. The printing and plotting routines included are set up for the same hardware as described under Option 1.

MAIN PROGRAM MENU: OPTION 1

If Option 1 of the main program menu is selected, the following menu appears on the screen:

```
                    OPTIONS
**************************************

  0   RETURN TO MAIN PROGRAM MENU

  1   INPUT CROSS-SECTION DATA

  2   CHANGE EXISTING CROSS-SECTION DATA FILE

  3   PRINT CROSS-SECTION DATA

  4   INPUT FIELD DRAWDOWN DATA
```

5 PRINT FIELD DRAWDOWN DATA

6 INPUT LIGHT METER DATA

7 PRINT LIGHT METER DATA

8 PRINT TURBIDITY DATA

9 PRINT ICE THICKNESS DATA

INPUT OPTION ?

This menu contains all of the routines programmed to store and print field data. They are set up to store data on a disk in the "B" drive, although this can be changed within the program. If it is changed to the "A" drive, or the drive that the program is loaded in, be sure to replace the program before selecting Option 0, RETURN TO MAIN PROGRAM MENU. All other options, 1-9, are stored in the computer's memory.

Option 0: Return to Main Program Menu

If Option 0 is selected, the computer returns to BEGIN. This allows the user to either end the session or move to the calculations mode.

Option 1: Input Cross-Section Data

Option 1 allows for input and storage of cross-section data. The parameters are distance to a point and elevation of the point. The distances are measured from a "0" point on the green side. It is best to

start the data at some point on shore to allow for possible changes in water surface elevation.

When Option 1 is selected, the following description appears on the screen:

```
THIS ROUTINE IS DESIGNED TO ALLOW INPUT
AND STORAGE OF CROSS-SECTION DATA.

ALL DISTANCES SHOULD BE INPUT FROM A BASE
ON THE GREEN SIDE WHICH IS THE LEFT SIDE
LOOKING UP RIVER.
INPUT DATA AS      DISTANCE,ELEVATION
FOR EACH DATA POINT.

              HIT SPACE BAR TO CONTINUE.
```

After pressing the space bar the prompt to enter data appears as follows:

```
ENTER DISTANCE FROM REFERENCE(X) AND ELEVATION(Y),
      (enter (-1,0) to end data entry)
```

Enter all of the desired data points, one set at a time. Notice that each pair is separated by a comma and must be followed by return or enter key. When all of the data pairs have been entered, type "-1,0" to end entry as follows:

```
ENTER DISTANCE FROM REFERENCE(X) AND ELEVATION(Y),
(enter (-1,0) to end data entry) -1,0
```

After data entry has been finished, the following text appears on the screen:

```
CHECK DATA TO SEE IF YOU WANT TO MAKE ANY CHANGES

DATA WILL BE DISPLAYED 20 LINES AT A TIME.

HIT SPACE BAR TO CONTINUE.
```

At this point, the data can be checked to see if any points were entered improperly. For purposes of explanation in this manual, a small data file was entered. After pressing the space bar the file is displayed on the screen:

```
DATA POINT    DISTANCE(X)      ELEVATION(Y)
 1              100              600
 2              200              599
 3              300              595
 4              400              590
 5              500              580
 6              600              570
 7              700              570
 8              800              580
 9              900              590
 10             1000             595
 11             1100             600
DO YOU WANT TO CHANGE ANY DATA POINTS (Yes/No)
```

Notice that at the bottom of the display, the user is prompted to change any points desired. If all of the data are correct, type "NO" and the computer will move to the data storage routine. To change a point or points type "YES" and the screen prompts:

```
ENTER DATA POINT  6

ENTER DISTANCE(X) AND ELEVATION(Y)  600,575
```

Here data point 6 was entered and changed to 600,575 as shown above. After the two prompts are answered the data are redisplayed as:

```
DATA POINT    DISTANCE(X)      ELEVATION(Y)
 1              100              600
 2              200              599
 3              300              595
 4              400              590
 5              500              580
 6              600              575
 7              700              570
 8              800              580
 9              900              590
 10             1000             595
 11             1100             600
DO YOU WANT TO CHANGE ANY DATA POINTS (Yes/No)
```

Notice that point 6 has been changed. If it is desired to add a point to the file, enter the data point number that is next in the file along with the distance and elevation as shown:

```
ENTER DATA POINT  12

ENTER DISTANCE(X) AND ELEVATION(Y)  1200,600
```

After entering the changes the data are redisplayed as:

```
DATA POINT    DISTANCE(X)      ELEVATION(Y)
 1              100              600
 2              200              599
 3              300              595
 4              400              590
 5              500              580
```

```
6               600             575
7               700             570
8               800             580
9               900             590
10              1000            595
11              1100            600
12              1200            600
DO YOU WANT TO CHANGE ANY DATA POINTS (Yes/No)
```

Data point 12 has been added. If the point that was added is in the middle of the file, it will still be displayed at the end. It will be put into the correct order in the file before being stored.

Once all desired data points have been changed or added, the computer sorts the values and puts them in order of distance from green side baseline. The following prompt then appears on the screen:

```
PUT DATA DISK IN DRIVE 'B'

HIT SPACE BAR TO CONTINUE.
```

At this time, insert the data storage disk in drive B and press the space bar.

The following series of questions now comes up in order. Answer each question with a return or enter. The water surface elevation is the elevation at the time the sounding data were collected:

```
INPUT NAME OF NEW DATA FILE B:TEST

NAME OF SECTION  ? TEST

DATE OF SOUNDING ? 1/1/85

WATER SURFACE ELEVATION = ? 600
```

After all of the prompts have been answered, the data is stored under the name entered and the screen reverts to the data input menu for a new option input.

Option 2: Change Existing Cross-Section Data File

After cross-section data have been stored on the data disk, they can be recalled and points changed or added using this routine.

If Option 2 is selected, the following description appears on the screen:

```
THIS ROUTINE IS DESIGNED TO ALLOW CHANGES
OF AN EXISTING CROSS-SECTION DATA FILE.
AFTER THE DATA HAS BEEN READ IT WILL BE
DISPLAYED 20 LINES AT A TIME TO DETERMINE
WHICH POINTS ARE TO BE CHANGED. THE NEW FILE
WILL THEN BE STORED ON THE DATA DISK.TO ADD
A POINT INPUT THE NEXT NUMBER AFTER THE LAST
DATA POINT IN THE FILE AND THE COMPUTER WILL
STORE IT IN ITS CORRECT PLACE IN THE FILE.
        PUT DATA DISK IN DRIVE 'B'
        HIT SPACE BAR TO CONTINUE.
```

When the space bar is pressed, the user is prompted for the name of the data file and the information shown below is printed on the display:

```
INPUT NAME OF DATA FILE B:TEST

NAME OF SECTION    TEST

DATE OF SOUNDING    1/1/85

WATER SURFACE ELEVATION AT DATE =    600

NUMBER OF DATA POINTS =    12


END OF DATA FILE    B:TEST

HIT SPACE BAR TO CONTINUE.
```

This is the same file that was entered in the earlier section. The parameters are shown as they were read from the disk.

Press the space bar and the next screen shows:

DATA POINT	DISTANCE(X)	ELEVATION(Y)
1	100	600
2	200	599
3	300	595
4	400	590
5	500	580
6	600	575
7	700	570
8	800	580

9	900	590
10	1000	595
11	1100	600
12	1200	600

DO YOU WANT TO CHANGE ANY OF THESE DATA POINTS (Yes/No)

The procedure for changing points is the same, however, if there are more data points.

Assume that it is desired to change point 6 to 600,577. Enter the data as:

ENTER POINT YOU WANT TO CHANGE OR ADD,

DISTANCE(X),AND ELEVATION(Y)6,600,577

Notice that the three parameters are separated by two commas. After the change has been made and entered, the file is redisplayed as:

DATA POINT	DISTANCE(X)	ELEVATION(Y)
1	100	600
2	200	599
3	300	595
4	400	590
5	500	580
6	600	577
7	700	570
8	800	580
9	900	590

10	1000	595
11	1100	600
12	1200	600

DO YOU WANT TO CHANGE ANY OF THESE DATA POINTS (Yes/No)

Notice that data point 6 has the new values. To add a point within the file, enter the next number in line followed by the required distance and elevation as:

ENTER POINT YOU WANT TO CHANGE OR ADD,

DISTANCE(X),AND ELEVATION(Y)13,750,575

This file is then reprinted on the screen as:

DATA POINT	DISTANCE(X)	ELEVATION(Y)
1	100	600
2	200	599
3	300	595
4	400	590
5	500	580
6	600	577
7	700	570
8	800	580
9	900	590
10	1000	595
11	1100	600
12	1200	600
13	750	575

DO YOU WANT TO CHANGE ANY OF THESE DATA POINTS (Yes/No)

Notice that the data are left as point number 13, although this is not the correct order. It will be put into the order by distance before it is stored on the data disk.

When all of the changes have been made, enter "NO" and the prompt is:

```
PUT DATA DISK IN DRIVE 'B'

HIT SPACE BAR TO CONTINUE.
```

Insert the disk, press the space bar and answer these questions as in Option 1.

```
INPUT NAME OF NEW DATA FILE B:TEST1
NAME OF SECTION  ? TEST
DATE OF SOUNDING ? 1/1/85
WATER SURFACE ELEVATION = ? 600
```

If it is desired to save the previous file unchanged, enter a different name than before. In this example, TEST1 is used as a new file name. Both files are now stored on the disk. After all parameters have been entered the PC returns to the data input menu.

Option 3: Print Cross-Section Data

This routine will print out a hard copy of the data stored on the disk. When Option 3 is selected this text appears:

```
PUT PRINTER ON LINE - PLACE PRINTER HEAD
AT THE TOP OF THE PAGE.

PUT DATA DISK IN DRIVE 'B'

HIT SPACE BAR TO CONTINUE.
```

Place the printer head on the perforated line at the top of the page, put the data disk in the drive and press the space bar.

The user is then prompted for the data file name to be printed as:

```
INPUT NAME OF DATA FILE B:TEST1

NAME OF SECTION    TEST
DATE OF SOUNDING    1/1/85
WATER SURFACE ELEVATION AT DATE =    600
```

```
NUMBER OF DATA POINTS =    13

END OF DATA FILE    B:TEST1

HIT SPACE BAR TO CONTINUE.
```

After hitting the space bar, the data are sent to the printer and the table shown in Figure 1 is the result. If there are more data than will fit on one page, the routine will put the bottom margin on the sheet and move to a continued heading on the next page, along with the rest of the data.

Option 4: Input Field Drawdown Data

Option 4 uses basically the same format for entering data as Option 1. The first display to appear on the screen is:

```
THIS ROUTINE IS DESIGNED TO ALLOW INPUT
AND STORAGE OF DRAWDOWN DATA.

ALL DISTANCES SHOULD BE INPUT FROM A BASE
ON THE GREEN SIDE WHICH IS THE LEFT SIDE
LOOKING UP RIVER.
INPUT DATA AS       TIME,GAUGE READING
FOR EACH DATA POINT.

                HIT SPACE BAR TO CONTINUE.
```

SOUNDING DATA

NAME OF SECTION TEST

DATE OF SOUNDING 1/1/85

WATER SURFACE ELEVATION in feet = 600

DATA POINT	DISTANCE(ft)	ELEVATION(ft)
1	100.0	600.0
2	200.0	599.0
3	300.0	595.0
4	400.0	590.0
5	500.0	580.0
6	600.0	577.0
7	700.0	570.0
8	750.0	575.0
9	800.0	580.0
10	900.0	590.0
11	1000.0	595.0
12	1100.0	600.0
13	1200.0	600.0

Figure 1 Test Sounding Data

After pressing the space bar, the user is prompted to enter data as:

TIME FROM '0' in sec. AND GAUGE READING

in inches-(enter (-1,0) to end data entry)

Time from "0" is the time that each staff gauge reading is made. "0" time is the start time before the vessel reaches the observation line. The gauge reads the water surface at a given time. Enter the data in pairs and again enter "-1,0" to end data entry. When all data are in, the following appears on the screen:

CHECK DATA TO SEE IF YOU WANT TO MAKE ANY CHANGES

DATA WILL BE DISPLAYED 20 LINES AT A TIME.

HIT SPACE BAR TO CONTINUE.

The data are again displayed 20 lines at a time as in Option 1. The file shown below was entered as an example.

```
DATA POINT      TIME(T)          READING(Y)
 1              0                10
 2              20               9
 3              40               8
 4              50               7
 5              60               6
 6              70               7
 7              80               8
 8              100              10
 9              120              11
 10             140              10
 11             160              10
DO YOU WANT TO CHANGE ANY DATA POINTS (Yes/No)
```

If any changes need to be made they are entered in the same fashion as in Option 1. When the file is correct, the user is prompted to insert the data disk.

```
PUT DATA DISK IN DRIVE 'B'

HIT SPACE BAR TO CONTINUE.
```

After pressing the space bar, the following series of questions appears on the screen in this order:

```
INPUT NAME OF NEW DATA FILE B:DRAW
NAME OF SECTION  ? TEST
DATE OF OBSERVATION ? 1/1/85
VESSEL NAME  ? DRAWTEST
UPBOUND or DOWNBOUND  ? UPBOUND
VESSEL LENGTH (ft) = ? 730
VESSEL BEAM (ft) = ? 75
```

```
VESSEL DRAFT (ft) = ? 25
VESSEL SPEED (ft/sec) = ? 10
BOW ON TIME (sec) = ? 20
STERN ON TIME (sec) = ? 80
DISTANCE TO STAFF GAUGE from green side (ft) = ? 50
BACKGROUND READING (in) = ? 10
```

Answer all of the questions as appropriate. The "bow on time" and "stern on time" are the times that the bow and stern of the vessel cross the observation line. The background reading is the staff gauge reading before any effect of the oncoming vessel has occurred. When the last parameter has been entered, the data are stored on the disk and the screen returns to the data entry menu.

Option 5: Print Drawdown Data

Option 5 will print a hard copy of the drawdown data entered in Option 4 as Option 3 printed the cross-section data.

The first text to appear is:

```
PUT PRINTER ON LINE - PLACE PRINTER HEAD
AT THE TOP OF THE PAGE

PUT DATA DISK IN DRIVE 'B'

HIT SPACE BAR TO CONTINUE.
```

Again place the printer head at the top of the page, insert the data disk and press the space bar. The user is then prompted for the data file name as:

```
INPUT NAME OF NEW DATA FILE D:DRAW


NAME OF SECTION  TEST
DATE OF OBSERVATION 1/1/85
VESSEL NAME  DRAWTEST
UPBOUND or DOWNBOUND  UPBOUND
VESSEL LENGTH (ft) = 730
VESSEL BEAM (ft) = 75
VESSEL DRAFT (ft) = 25
VESSEL SPEED (ft/sec) = 10
BOW ON TIME (sec) = 20
STERN ON TIME (sec) = 80
DISTANCE TO STAFF GAUGE from green side (ft) = 50
BACKGROUND READING (in) =  10

              HIT SPACE BAR TO CONTINUE.
```

The parameters stored on the disk appear below the prompt as shown above. When the space bar is pressed the printout starts and the result is as is shown in Figure 2.

After the printout is complete, a prompt appears on the screen:

```
DO YOU WANT TO PRINT ANOTHER (Yes/No) ?
```

If "YES" is entered another printout is obtained. "NO" returns to the data entry menu.

@@@

DRAWDOWN DATA

NAME OF SECTION TEST

@@@

DATE OF OBSERVATION 1/1/85

VESSEL NAME DRAWTEST

DIRECTION UPBOUND

VESSEL LENGTH in feet = 730

VESSEL BEAM in feet = 75

VESSEL DRAFT in feet = 25

VESSEL SPEED in feet/sec. = 10

BOW ON TIME in sec = 20

STERN ON TIME in sec = 80

DISTANCE TO STAFF GAUGE from green side in feet = 50

BACKGROUND READING in inches = 10

DATA POINT	TIME(sec)	GAUGE READING(in)	CHANGE FROM BG(in)
1	0.0	10.0	0.0
2	20.0	9.0	-1.0
3	40.0	8.0	-2.0
4	50.0	7.0	-3.0
5	60.0	6.0	-4.0
6	70.0	7.0	-3.0
7	80.0	8.0	-2.0
8	100.0	10.0	0.0
9	120.0	11.0	1.0
10	140.0	10.0	0.0
11	160.0	10.0	0.0

Figure 2 Test Drawdown Data

Option 6: Input Light Meter Data

This option is designed for the entry and storage of light meter data. The device and procedure used to collect the data can be found in the main report. When Option 6 is selected, the following routine description appears:

```
THIS ROUTINE ALLOWS FOR INPUT OF LIGHT
METER DATA. AFTER ALL VALUES HAVE BEEN
INPUT THEY WILL BE STORED ON THE DATA DISK.
INPUT DATA AS    DEPTH,READING
FOR EACH POINT.

PUT DATA DISK IN DRIVE B
HIT ANY KEY TO CONTINUE
```

Put the data disk in the drive and hit the space bar. The list of questions shown below must then be answered.

```
FILE NAME?  B:LIGHT
SITE NAME ? TEST
RDG LOCATION (dist off green side?)? 500
OVERHEAD READING ? 2000
ICE THICKNESS in. (0 for ice free conditions) ? 0
READING JUST UNDER SURFACE OR ICE SHEET ? 1800
```

The main report explains what each reading is when the light meter is used. After these parameters are entered the data are put in as follows:

```
ENTER DATA POINT -- DEPTH of reading ft,METER READING
INPUT -9999,0 TO FINISH DATA INPUT
DATA PAIR NO. 1 =
? 2,1700
DATA PAIR NO. 2 =
? 5,1400
DATA PAIR NO. 3 =
? 10,1000
DATA PAIR NO. 4 =
? 15,700
DATA PAIR NO. 5 =
? 20,400
DATA PAIR NO. 6 =
? -9999,0
```

Enter each pair as depth of reading and reading separated by a comma. When all of the data have been entered type "-9999,0" and the file will be stored on the disk. The computer then returns to the data entry menu.

Option 7: Print Light Meter Data

When Option 7 is selected, the first display is:

```
PUT PRINTER ON LINE - PLACE PRINTER HEAD
AT THE TOP OF THE PAGE
```

```
PUT DATA DISK IN DRIVE B

HIT ANY KEY TO CONTINUE
```

Place the printer head as in Options 3 and 5 and put the light meter data disk in the drive. After pressing any key the user is prompted for the file name, and the following data appear on the screen from the stored file.

```
   FILE NAME?  B:LIGHT

TEST
DISTANCE =     500
OVERHEAD READING =              2000
ICE THICKNESS =                 0 in.
READING UNDER SURFACE =         1800
 1 .  2     1700
 2 .  5     1400
 3 .  10     1000
 4 .  15     700
 5 .  20     400

 END OF DATA FILE  B:LIGHT

HIT ANY KEY TO CONTINUE
```

Press any key and these questions are prompted in order.

```
DATE OF READINGS ? 1/1/85
TIME OF READINGS ? 1:00 PM
```

```
SKY WAS (CLEAR/CLOUDY)? CLEAR
ICE CONDITION (NO ICE/NO SNOW/SNOWCOVERED) ? NO ICE
TOTAL DEPTH AT LOCATION (ft) ? 34
WERE TURBIDITY SAMPLES TAKEN (Y/N)? Y

INPUT DEPTH OF SAMPLE(ft),TURBIDITY(JTU)? 10,1
MORE SAMPLES (Y/N) ? N
```

If "NO ICE" or "NO SNOW" is entered for the ice condition the above questions will be the result. If "SNOWCOVERED" is entered the parameters that follow are also included. The words "NO ICE", "NO SNOW" and "SNOW-COVERED" must be spelled correctly.

```
DATE OF READINGS ? 1/1/85
TIME OF READINGS ? 1:00 PM

SKY WAS (CLEAR/CLOUDY)? CLOUDY
ICE CONDITION (NO ICE/NO SNOW/SNOWCOVERED) ? SNOWCOVERED
PERCENTAGE SNOW ON ICE ? 20
DEPTH OF SNOW ON ICE (in)? 3
TOTAL DEPTH AT LOCATION (ft) ? 34
WERE TURBIDITY SAMPLES TAKEN (Y/N)? N
```

To enter turbidity readings taken at the same time, if there are any, answer the last question "yes" and the prompt that was shown two lists above will appear for each turbidity reading. Enter the depth of the reading and the turbidity separated by a comma.

When all data have been entered, they are sent to the printer and Figure 3 is the result. If no turbidities were measured, the printout looks like Figure 4. After printing is complete the computer returns to the data entry menu.

LIGHT METER READINGS

SITE NAME TEST
READING LOCATION (dist. from green side ft) 500

DATE 1/1/85
TIME 1:00 PM
SKY WAS CLEAR
TOTAL DEPTH AT LOCATION (ft) 34

OVERHEAD LIGHT READING 2000
LIGHT READING JUST UNDER WATER SURFACE 1800

DEPTH OF READING(ft)	LIGHT METER READING	TURBIDITY (JTU)
2.0	1700.00	
5.0	1400.00	
10.0	1000.00	1.00
15.0	700.00	
20.0	400.00	

Figure 3 Test Light Meter Data

LIGHT METER READINGS

SITE NAME TEST
READING LOCATION (dist. from green side ft) 500

DATE 1/1/85
TIME 1:00 PM
SKY WAS CLOUDY
ICE CONDITION SNOWCOVERED
PERCENTAGE SNOW ON ICE 20
DEPTH OF SNOW ON ICE (in) 3
ICE THICKNESS (in) 0
TOTAL DEPTH AT LOCATION (ft) 34

OVERHEAD LIGHT READING 2000
LIGHT READING JUST UNDER ICE 1800

DEPTH OF *** READING ***	LIGHT METER *** READING ***
2.0	1700.00
5.0	1400.00
10.0	1000.00
15.0	700.00
20.0	400.00

Figure 4 Test Light Meter Data with Ice Cover

Option 8: Print Turbidity Data

Turbidity data can be printed using Option 8. The first prompt after the selection of 8 is:

```
PUT PRINTER ON LINE - PLACE PRINTER HEAD
AT THE TOP OF THE PAGE

HIT SPACE BAR TO CONTINUE.
```

Place the printer head as in earlier printout options and press the space bar. The next three questions result.

```
SITE NAME ? TEST
DATE OF READINGS ? 1/1/85
NUMBER OF SAMPLING LOCATIONS? 3
```

The number of sampling locations are the number of positions at different distances along the observation line or river cross-section. When these three prompts have been answered, the user is asked to enter the data for each sampling location. An example of this is as follows:

```
DISTANCE TO LOCATION  1 (from green side in feet)
? 500

TOTAL DEPTH AT LOCATION  1 (ft)
? 10
INPUT DEPTH OF SAMPLE,TURBIDITY(JTU)
? 5,1
INPUT MORE DATA FOR LOCATION 1 Y/N?
? N
```

```
DISTANCE TO LOCATION  2 (from green side in feet)
? 1000

TOTAL DEPTH AT LOCATION  2 (ft)
? 30
INPUT DEPTH OF SAMPLE,TURBIDITY(JTU)
? 10,1
INPUT MORE DATA FOR LOCATION 2 Y/N?
? Y
INPUT DEPTH OF SAMPLE,TURBIDITY(JTU)
? 20,1
INPUT MORE DATA FOR LOCATION 2 Y/N?
? N


DISTANCE TO LOCATION  3 (from green side in feet)
? 1500

TOTAL DEPTH AT LOCATION  3 (ft)
? 10
INPUT DEPTH OF SAMPLE,TURBIDITY(JTU)
? 5,1
INPUT MORE DATA FOR LOCATION 3 Y/N?
? N
```

Any number of samples can be entered at different depths for each location. After the last turbidity value has been entered for the final location, the data are sent to the printer and the result is as shown in Figure 5. When printing is completed, the data entry menu reappears on the screen.

Option 9: Print Ice Thickness Data

Option 9 will produce a hard copy of ice thickness at various locations along a cross-section line. The first display is:

TURBIDITY READINGS

SITE NAME TEST

DATE 1/1/85

TOTAL DEPTH AT LOCATION 1 (ft) 10
TOTAL DEPTH AT LOCATION 2 (ft) 30
TOTAL DEPTH AT LOCATION 3 (ft) 10

ALL DISTANCES ARE FROM THE GREEN SIDE BASELINE

	DIST. TO *** SAMPLE(ft) ***	DEPTH OF *** SAMPLE ***	TURBIDITY *** (JTU) ***
LOCATION 1	500.0		
		5.0	1.00
LOCATION 2	1000.0		
		10.0	1.00
		20.0	1.00
LOCATION 3	1500.0		
		5.0	1.00

Figure 5 Test Turbidity Readings

```
PUT PRINTER ON LINE - PLACE PRINTER HEAD
AT THE TOP OF THE PAGE

          HIT SPACE BAR TO CONTINUE.
```

Place the printer head as before, press the space bar and answer the following questions.

```
SITE NAME ? TEST
DATE OF READINGS ? 1/1/85
```

Next enter the data as distance to location followed by the depth at the location and the ice thickness separated by a comma. An example of some data is:

```
DISTANCE TO LOCATION  1 (from green side in feet)
? 500
INPUT DEPTH AT LOC.(ft),ICE THICKNESS(in)
? 10,12
INPUT MORE DATA Y/N?
? Y

DISTANCE TO LOCATION  2 (from green side in feet)
? 1000
INPUT DEPTH AT LOC.(ft),ICE THICKNESS(in)
? 30,12
INPUT MORE DATA Y/N?
? Y
```

```
DISTANCE TO LOCATION  3 (from green side in feet)
? 1500
INPUT DEPTH AT LOC.(ft),ICE THICKNESS(in)
? 10,12
INPUT MORE DATA Y/N?
? N
```

Type "NO" for "input more data?" when all the sampling locations have been entered. The data are then sent to the printer as shown in Figure 6. After printing is complete the screen returns to the data entry menu.

This completes the description of the routines contained under Option 1 of the main program menu and TWO.SUB. The user should attempt the examples contained in this section of the manual to clarify its use.

MAIN PROGRAM MENU: OPTION 2

Option 2 of the main program menu, PERFORM CALCULATIONS, contains the various routines required to calculate areas of cross-sections, drawdowns and relative damage, and light extinction coefficients.

If Option 2 is selected at the beginning of the program, the subroutine BEGIN loads the subroutine ONE.SUB into memory.

The following menu is the first thing to appear on the screen:

```
                    OPTIONS

**************************************************

  0   RETURN TO MAIN PROGRAM MENU

  1   CALCULATE AREAS AND TOPWIDTHS OF CROSS-SECTIONS

  2   CALCULATE DRAWDOWNS USING A SINGLE VESSEL SPEED
      AND GIVE RELATIVE DAMAGE
```

ICE THICKNESSES

SITE NAME TEST

DATE 1/1/85

ALL DISTANCES ARE FROM THE GREEN SIDE BASELINE

	DIST. TO LOC.(ft)	DEPTH AT LOC.(ft)	ICE THICK (in.)
LOCATION 1	500.0	10.0	12.0
LOCATION 2	1000.0	30.0	12.0
LOCATION 3	1500.0	10.0	12.0

Figure 6 Test Ice Thicknesses

3 CALCULATE DRAWDOWNS ITERATING VESSEL SPEED AND GIVE RELATIVE DAMAGE

4 FIT LIGHT METER DATA TO LINE AND GIVE RESULTS

INPUT OPTION ?

Options 1, 2 and 4 are all contained in ONE.SUB. If Option 3 is selected, the computer loads THREE.SUB, which contains the program to iterate vessel speeds. Each of these options is explained in detail in the following sections of this manual. The various calculation routines contain printout and plotting subroutines that can be used if prompted. All calculated answers will be displayed on the screen before the prompts to redirect to the printer and/or plotter appear. This allows the program to be used effectively without printing and/or plotting unnecessary output.

Option 0: Return to Main Program Menu

If Option 0 is selected, the computer reloads BEGIN and the main program menu comes back on the screen. This allows the user to return to DOS or to the data input mode.

Option 1: Calculate Areas and Topwidths of Cross-Section

Option 1 allows the user to calculate the area of a given cross-section using data stored by Option 1 of the data input menu. It will calculate the area of water given the water surface elevation. It also calculates the topwidth of the section at that water surface elevation. The topwidth is the distance between the two points on opposite river banks that the water surface touches as calculated using the cross-section of the nearshore regions.

The routine also calculates the areas on both sides of a vessel when the distance to the center of the vessel is entered.

When Option 1 is selected, the following description appears on the screen:

```
THIS ROUTINE ALLOWS FOR CALCULATION OF AREAS
AND TOPWIDTHS OF RIVER SECTIONS USING STORED
CROSS-SECTION DATA. IT WILL CALCULATE THE TOTAL
AREA AND TOP WIDTH PLUS THE AREAS ON THE RED AND
GREEN SIDES OF THE VESSEL.

PUT DATA DISK IN DRIVE 'B'.
HIT SPACE BAR TO CONTINUE.
```

Insert the data disk containing the cross-section data and press the space bar. The next prompt is for the name of the data file. For this description, a sample cross-section data file called EXAMPLE was entered using Option 1 of the data entry menu. After the data file name is entered the parameters at the beginning of the file are printed as follows:

```
INPUT NAME OF DATA FILE B:EXAMPLE

NAME OF SECTION    EXAMPLE
DATE OF SOUNDING   1/1/85
WATER SURFACE ELEVATION AT DATE =    100
NUMBER OF DATA POINTS =    25
END OF DATA FILE   B:EXAMPLE

HIT SPACE BAR TO CONTINUE.
```

Figure 7 is a printout obtained from Option 3 of the data entry menu of the sample file.

After pressing the space bar, these prompts must be answered in the order that they appear.

```
WATER SURFACE ELEVATION = WS = ? 100

ENTER DISTANCE TO UPBOUND VESSEL FROM GREEN SIDE in feet = ? 950

ENTER DISTANCE TO DOWNBOUND VESSEL FROM GREEN SIDE in feet = ? 1000
```

The water surface elevation that must be entered is the elevation at which the user wants the calculation to be made. In this case the water surface at the time that the sounding was made was used, although any reasonable water surface can be used.

The distance to the centers of upbound and downbound vessels allows for areas on both sides of the vessels to be calculated. Depth at the center of the vessel is just an average depth under the ship.

When all of the prompted parameters have been entered the computer asks the user to wait until the calculation is complete. After the computer has made the necessary calculations the first half of the results appears as:

SOUNDING DATA

NAME OF SECTION EXAMPLE

DATE OF SOUNDING 1/1/85

WATER SURFACE ELEVATION in feet = 100

DATA POINT	DISTANCE(ft)	ELEVATION(ft)
1	0.0	102.0
2	25.0	100.0
3	50.0	98.0
4	100.0	95.0
5	150.0	97.0
6	200.0	95.0
7	300.0	90.0
8	400.0	92.0
9	500.0	88.0
10	600.0	75.0
11	700.0	66.0
12	800.0	63.0
13	900.0	68.0
14	1000.0	66.0
15	1100.0	67.0
16	1200.0	70.0
17	1300.0	76.0
18	1400.0	80.0
19	1500.0	82.0
20	1600.0	87.0
21	1700.0	90.0
22	1800.0	92.0
23	1900.0	95.0
24	1950.0	97.0
25	2000.0	101.0

Figure 7 Example Sounding Data

```
NAME OF SECTION          EXAMPLE
WATER SURFACE ELEVATION in feet =  100.00
DISTANCE TO UPBOUND VESSEL from green side in feet =  950
DEPTH AT CENTER OF UPBOUND VESSEL in feet =  33
DISTANCE TO DOWNBOUND VESSEL from green side in feet =  1000
DEPTH AT CENTER OF DOWNBOUND VESSEL in feet =  34
TOTAL AREA OF SECTION in sq. feet =  36156.
          HIT SPACE BAR TO CONTINUE.
```

At this point the total area of the section should be recorded if the user cannot obtain a hard copy through a later prompt.

Press the space bar and the second half of the results is displayed as:

```
AREA ON GREEN SIDE OF UPBOUND VESSEL in sq. feet =  16700.
AREA ON RED SIDE OF UPBOUND VESSEL in sq. feet =  19456.
AREA ON GREEN SIDE OF DOWNBOUND VESSEL in sq. feet =  18350.
AREA ON RED SIDE OF DOWNBOUND VESSEL in sq. feet =  17806.
WIDTH OF WATER SURFACE in feet =  1962.5

DO YOU WANT A HARD COPY (Yes/No)?
```

```
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
   NAME OF SECTION      EXAMPLE


   WATER SURFACE ELEVATION in feet =  100.00
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@

   DISTANCE TO UPBOUND VESSEL from green side in feet =  950

   DEPTH AT CENTER OF UPBOUND VESSEL in feet =  33

   DISTANCE TO DOWNBOUND VESSEL from green side in feet =  1000

   DEPTH AT CENTER OF DOWNBOUND VESSEL in feet =  34

   TOTAL AREA OF SECTION in sq. feet =  36156.

   AREA ON GREEN SIDE OF UPBOUND VESSEL in sq. feet =  16700.

   AREA ON RED SIDE OF UPBOUND VESSEL in sq. feet =  19456.

   AREA ON GREEN SIDE OF DOWNBOUND VESSEL in sq. feet =  18350.

   AREA ON RED SIDE OF DOWNBOUND VESSEL in sq. feet =  17806.

   WIDTH OF WATER SURFACE in feet =   1962.5
```

Figure 8 Example Cross-Section Areas

Again if no hard copy will be made, the results should be recorded. If a printout is desired, answer the hard copy prompt with "Yes" and Figure 8 is the result. A "No" or the end of printing returns the user to the calculations menu.

Option 2: Calculate Drawdowns Using a Single Vessel Speed and Give Relative Damage

The program was written primarily for the outputs provided by Options 2 and 3. They are the routines that calculate vessel-induced drawdowns and associate a relative damage to them.

Option 2 calculates the drawdowns caused by a vessel passing at a given speed through a section upbound, downbound or in either direction. Drawdowns are calculated for each side of the vessel.

If Option 2 is selected, the following description appears on the screen:

```
THIS ROUTINE ALLOWS FOR CALCULATION OF DRAWDOWNS
AND DAMAGE FOR THE PASSAGE OF A VESSEL UPBOUND,
DOWNBOUND OR BOTH DIRECTIONS FOR A GIVEN SPEED.
IT WILL ALSO GIVE A PRINTOUT OF THE RESULTS
IF PROMPTED BY THE USER.

HIT SPACE BAR TO CONTINUE.
```

After pressing the space bar, the user is prompted to select the vessel direction:

```
CHOOSE ONE OF THE FOLLOWING OPTIONS

CALCULATE DRAWDOWNS FOR

 1              UPBOUND VESSEL ONLY

 2              DOWNBOUND VESSEL ONLY

 3              BOTH UPBOUND & DOWNBOUND VESSELS

                      INPUT OPTION  ? 3
```

The user selects one of the three options, and the following six questions are asked, one at a time:

```
NAME OF SECTION   EXAMPLE

AREA ON GREEN SIDE OF UPBOUND VESSEL in sq. feet = ? 16700

AREA ON RED SIDE OF UPBOUND VESSEL in sq. feet = ? 19456

AREA ON GREEN SIDE OF DOWNBOUND VESSEL in sq. feet = ? 18350

AREA ON RED SIDE OF DOWNBOUND VESSEL in sq. feet = ? 17806

WIDTH OF WATER SURFACE in feet = ? 1962.5
```

Notice that the information prompted by these six questions can be obtained by Option 1 of the calculations menu. For purposes of this example, the results of the example for Option 1, calculation of area, will be used for the prompted parameters. To show how results are obtained for both upbound and downbound vessels, Option 3 for direction was chosen. If either of the other two options is selected, the same questions are asked, but only for the vessel direction desired.

After the six cross-section parameters have been entered, the following text and two prompts appear on the screen:

```
THE FOLLOWING TWO INPUT PARAMETERS ALLOW
EXAMINATION OF THE ICE COVERED CONDITION
ON THE SYSTEM. INPUT PERCENTAGE OF AREA
TAKEN UP BY ICE AS A DECIMEL MULTIPLIER
OF THE TOTAL AREA OF THE SECTION. INPUT
O FOR ICE FREE CONDITIONS.

PERCENTAGE ICE on green side (decimal form) = ? .052
PERCENTAGE ICE on red side (decimal form) = ? .056
```

To determine what the parameter for percentage of ice is, calculate the submerged area of ice on the green and red sides of the vessel and divide that value by the area of water that would be present in the section at that water surface with no ice present. This is the percentage of ice in decimal form. If free water surface conditions are present, enter zeros for these two parameters.

After the ice condition parameters have been entered, the next option menu is printed on the screen.

```
INPUT THE NEARSHORE CONFIGURATION ON THE GREEN SIDE

CHOOSE ONE OF THE FOLLOWING OPTIONS

 1              OPEN BLUFF OR ESCARPMENT

 2              OPEN SLOPING BEACH

 3              SUBMERGED WETLANDS

 4              MANMADE PROTECTION

                      INPUT OPTION  ? 2
```

Select the number of the configuration that best fits the shoreline area on the green side. A description of these four nearshore types can be found in the main report. Next select the soil type on the green side by the menu:

```
INPUT THE NEARSHORE SOIL TYPE ON THE GREEN SIDE

CHOOSE ONE OF THE FOLLOWING OPTIONS

 1              BOULDERS AND/OR COBBLES

 2              COARSE TO MEDIUM SAND

 3              MEDIUM SAND TO SILT

 4              CLAY

                      INPUT OPTION  ? 3
```

These four major soil types are also described in the main report.

After this parameter has been selected, the same two menus appear for the nearshore area on the red side:

```
INPUT THE NEARSHORE CONFIGURATION ON THE RED SIDE

CHOOSE ONE OF THE FOLLOWING OPTIONS

 1              OPEN BLUFF OR ESCARPMENT

 2              OPEN SLOPING BEACH

 3              SUBMERGED WETLANDS

 4              MANMADE PROTECTION

                      INPUT OPTION  ? 1
```

```
INPUT THE NEARSHORE SOIL TYPE ON THE RED SIDE

CHOOSE ONE OF THE FOLLOWING OPTIONS

 1              BOULDERS AND/OR COBBLES

 2              COARSE TO MEDIUM SAND

 3              MEDIUM SAND TO SILT

 4              CLAY

                      INPUT OPTION  ? 4
```

Select the parameters for the red side in the same manner as above.

When the four parameters describing the nearshore areas on both sides of the section have been entered, the user is prompted to answer the next eight questions:

```
DISTANCE TO UPBOUND VESSEL from green side in feet = ? 950
DISTANCE TO DOWNBOUND VESSEL from green side in feet = ? 1000
VESSEL BEAM in feet = ? 75
VESSEL DRAFT in feet = ? 25
RIVER VELOCITY in feet per sec. = ? 1
UPBOUND VESSEL VELOCITY in feet per sec. = ? 10
DOWNBOUND VESSEL VELOCITY in feet per sec. = ? 10
DEPTH AT CENTER OF CHANNEL in feet = ? 33
```

The distances to the vessels are measured from the green shoreline to the center line of the vessel when it is located in the section. The vessel beam is the width of the vessel at its widest point. This value can be obtained from published data.

The vessel draft is the average depth of water that the vessel draws as it is moving. River velocity is the average river velocity across the section. It can be obtained by simply dividing the flow by the total cross-sectional area at the site. The vessel velocity is the speed that would be computed by a person standing on shore timing the ship as it passes "bow on" to "stern on" on the cross-section line. Finally the depth at the center of the channel is the average depth under the vessel.

After the depth has been entered, the user is requested to wait while the calculations are being made. When the calculations are complete, the results appear on the screen:

```
DRAWDOWN OF UPBOUND VESSEL on the green side (ft) =  0.34
DRAWDOWN OF UPBOUND VESSEL on the red side (ft) =  0.27

CRITICAL DRAWDOWN on the green side (ft) =  5.53
CRITICAL DRAWDOWN on the red side (ft) =  6.48
```

```
DAMAGE PROBABILITY GREEN IS NONE TO LIGHT

DAMAGE PROBABILITY RED IS NONE TO LIGHT

HIT SPACE BAR FOR DOWNBOUND RESULTS
```

Press the space bar and the rest of the results are printed:

```
DRAWDOWN OF DOWNBOUND VESSEL on the green side (ft) =  0.18
DRAWDOWN OF DOWNBOUND VESSEL on the red side (ft) =  0.18

CRITICAL DRAWDOWN on the green side (ft) =  7.33
CRITICAL DRAWDOWN on the red side (ft) =  7.34

DAMAGE PROBABILITY GREEN IS NONE TO LIGHT

DAMAGE PROBABILITY RED IS NONE TO LIGHT

**************************************************

DO YOU WANT A HARD COPY (Yes/No)?
```

Depending on the selection of vessel direction, one or the other of these sets of results may be omitted. The calculated values are given as the drawdowns on both sides of the vessel using the parameters entered. The critical drawdown is the drawdown at which critical conditions would exist for the given combination of inputs. The damage probability is the relative damage associated with that vessel passage.

The results are followed by the prompt "Do you want a hard copy?" If a "Yes" is entered the user is prompted to put the printer on line and Figure 9 is the result. All of the input values along with the calculated results are on the printout. If a single vessel direction was selected, only the appropriate values would be printed.

```
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@

NAME OF SECTION              EXAMPLE

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@

AREA ON GREEN SIDE OF UPBOUND VESSEL (sq. ft) =          16700
AREA ON RED SIDE OF UPBOUND VESSEL (sq. ft) =            19456
AREA ON GREEN SIDE OF DOWNBOUND VESSEL (sq. ft) =        18350
AREA ON RED SIDE OF DOWNBOUND VESSEL (sq. ft) =          17806
NEARSHORE GREEN -          OPEN SLOPING BEACH
SOIL TYPE GREEN -          MEDIUM SAND TO SILT
NEARSHORE RED -            OPEN BLUFF OR ESCARPMENT
SOIL TYPE RED -            CLAY
PERCENTAGE ICE on green side (decimal form) =            .052
PERCENTAGE ICE on red side (decimal form) =              .056
WIDTH OF WATER SURFACE (ft) =              1962.5
DISTANCE TO UPBOUND VESSEL from green side (ft) =        950
DISTANCE TO DOWNBOUND VESSEL from green side (ft) =      1000
VESSEL BEAM (ft) =          75
VESSEL DRAFT (ft) =         25
RIVER VELOCITY (ft per sec.) =             1
UPBOUND VESSEL VELOCITY (ft per sec.) =                  10
DOWNBOUND VESSEL VELOCITY (ft per sec.) =                10
DEPTH AT CENTER OF CHANNEL (ft) =          33

**********************************************************************

DRAWDOWN OF UPBOUND VESSEL on the green side (ft) =  0.34
DRAWDOWN OF UPBOUND VESSEL on the red side (ft) =  0.27

CRITICAL DRAWDOWN on the green side (ft) =  5.53
CRITICAL DRAWDOWN on the red side (ft) =  6.48

PROBABLE DAMAGE GREEN SIDE = NONE TO LIGHT
PROBABLE DAMAGE RED SIDE = NONE TO LIGHT

**********************************************************************

DRAWDOWN OF DOWNBOUND VESSEL on the green side (ft) =  0.18
DRAWDOWN OF DOWNBOUND VESSEL on the red side (ft) =  0.18

CRITICAL DRAWDOWN on the green side (ft) =  7.33
CRITICAL DRAWDOWN on the red side (ft) =  7.34

PROBABLE DAMAGE GREEN SIDE = NONE TO LIGHT
PROBABLE DAMAGE RED SIDE = NONE TO LIGHT

**********************************************************************
```

Figure 9 Example Drawdowns

A "No" response to the hard copy prompt, or the end of printing, results in the next user option:

```
DO YOU WANT A ANOTHER COPY (Yes/No)? N

DO YOU WANT TO TRY OTHER DATA (Yes/No)?
```

At this point, any of the parameters can be changed, and the drawdowns re-calculated using these new values. To try other parameters type "Yes". If "No" is entered, the user is returned to the calculation menu.

When it is desired to change one or more parameters by entering "Yes", the following description is printed:

```
THE FOLLOWING MENU ALLOWS FOR CHANGES IN THE DATA JUST RUN

INPUT OPTION # OF PARAMETER YOU WANT TO CHANGE.

THE OPTIONS ARE BROKEN INTO 2 LISTS

OPTION 'O' WILL RECALCULATE THE DRAWDOWNS WITH THE NUMBERS CHANGED

HIT SPACE BAR TO CONTINUE.
```

There are two menus included in this subroutine. There is an option in each to move back and forth between them. A "0" input will recalculate the drawdowns with the changed parameters.

After pressing the space bar at the end of the subroutine description, this option menu comes up on the monitor:

```
0          RECALCULATE DRAWDOWNS WITH DATA CHANGED
1          AREA ON GREEN SIDE OF UPBOUND VESSEL
2          AREA ON RED SIDE OF UPBOUND VESSEL
3          AREA ON GREEN SIDE OF DOWNBOUND VESSEL
4          AREA ON RED SIDE OF DOWNBOUND VESSEL
5          PERCENTAGE ICE ON GREEN SIDE
6          PERCENTAGE ICE ON RED SIDE
7          DISTANCE TO UPBOUND VESSEL
8          DISTANCE TO DOWNBOUND VESSEL
9          SECOND LIST OF INPUT DATA
                              OPTION #     ?
```

If it is desired to change one of the values in this list, type the number of the parameter and the prompt to enter the new value is printed on the screen. If the parameter to be changed is not in the list, enter a "9" and the second list will be printed on the screen as:

```
0          RECALCULATE DRAWDOWNS WITH DATA CHANGED
1          WIDTH OF WATER SURFACE
2          VESSEL BEAM
3          VESSEL DRAFT
4          RIVER VELOCITY
5          UPBOUND VESSEL VELOCITY
```

```
6          DOWNBOUND VESSEL VELOCITY

7          DEPTH AT CENTER OF CHANNEL

8          FIRST LIST OF INPUT DATA

                                   OPTION #     ?
```

Again there is an option, "8", to return to the first menu. A "0" will recalculate with changed parameters. If one of the change parameter options is chosen the user is again prompted on the screen to enter the new value.

To give an example of changing values and also to show a result that could appear on the screen during calculation, Option 7 of the second list was chosen. The prompt on the screen is:

```
DEPTH AT CENTER OF CHANNEL in feet = ? 25.1
```

The depth at the center of the channel is entered as 25.1 ft. and the screen returns to the first list. After entering a "0" the computer goes back to recalculate the drawdowns with this one parameter changed.

During the process of the calculation, the following comes up on the monitor:

```
THE PARAMETERS INPUT FOR THE UPBOUND VESSEL

CREATE A DRAWDOWN LARGE ENOUGH

TO GROUND THE VESSEL. THE DRAWDOWN
```

ADDED TO THE DRAFT IS GREATER THAN

THE DEPTH IN THE CENTER OF THE CHANNEL.

DO YOU WANT TO CHANGE ANY PARAMETERS (Yes/No) ?

The draft of the vessel is 25 ft. With a depth under the vessel of 25.1 ft. the drawdown of the ship can only get to 0.1 ft. before it hits the bottom. Therefore, the combination of values input is not possible. If the prompt to change parameters is answered "Yes", the user is taken back to the change parameters menus. A "No" returns the program to calculations if a downbound vessel direction was entered, otherwise the results are printed on the screen as before. The printout on the monitor and also on the hard copy if desired will reflect on the fact that the vessel grounded itself before it got to the calculated drawdown.

To give an example of another possibility during the calculation, the vessel speed changed as follows:

UPBOUND VESSEL VELOCITY in feet per sec. = ? 17

After entering a "0" to recalculate, the screen shows:

THE PARAMETERS INPUT FOR THE UPBOUND VESSEL

HAVE FORCED THE FLOW TO GO CRITICAL

ON THE GREEN SIDE.

THE STEADY STATE MODEL DOES NOT APPLY

BEYOND THIS POINT.

THE PROBABILITY FOR DAMAGE IS SEVERE.

CRITICAL DRAWDOWN on the green side (ft) = 1.59

DO YOU WANT TO CHANGE ANY PARAMETERS (Yes/No) ?

When the calculation is attempted using an upbound vessel velocity of 17 ft. per second, the flow becomes critical in the section. When critical conditions are reached, the steady state equations within the program do not apply. Therefore, the calculation cannot go any further. The damage probability at this point has already become severe and there is no reason to continue. If the user wants to change parameters, a "Yes" will again return to the change menus. A "No" will continue into the downbound calculation or the results will be printed on the screen. The results will reflect the fact that the flow became critical if no changes are made.

The above example is intended to give a full explanation of the procedure to be followed to calculate the drawdowns and relative damages for vessel passages through a section at a single speed. If it is desired to iterate vessel speed to critical, Option 3 can be used.

Option 3: Calculate Drawdowns Iterating Vessel Speed and Give Relative Damage

If Option 3 is selected, the computer automatically loads the subroutine THREE.SUB into memory. Before selecting 3 the disk must be in the drive. After the program is loaded, the following description appears on the screen:

```
THIS ROUTINE IS DESIGNED TO ITERATE UPBOUND
AND DOWNBOUND VESSEL VELOCITIES AND CALCULATE
THE CORRESPONDING DRAWDOWN. CALCULATIONS WILL
BE TERMINATED WHEN CRITICAL CONDITIONS ARE
REACHED ON ONE SIDE OF THE VESSEL OR THE OTHER.
BEGIN VELOCITY IS THE POINT THAT THE USER WANTS
ITERATION TO START.

HIT SPACE BAR TO CONTINUE.
```

The prompts for information to perform the calculations in this routine are the same as those for Option 2 except for the two vessel velocity questions. Under Option 3, these two questions are worded:

```
BEGIN UPBOUND VELOCITY in feet per sec. = ? 3
BEGIN DOWNBOUND VELOCITY in feet per sec. = ? 3
```

The "begin vessel velocity" is the speed at which the user wants the iteration to begin. The computer will calculate the drawdown for this speed. It then iterates the velocity by 0.5 ft. per second and calculates that drawdown until critical conditions are reached. At this point, the computer goes back to the last value for speed and advances by 0.05 from this point until critical conditions are reached again.

When the calculations for the desired vessel directions have been completed the results appear as:

THE CALCULATION REACHED CRITICAL CONDITIONS

ON THE GREEN SIDE OF THE UPBOUND VESSEL AT 15.45 ft/sec

DAMAGE PROBABILITY GREEN SIDE IS

NONE TO LIGHT FROM 0 ft/sec to 11.96 ft/sec

MODERATE from 11.96 ft/sec to 13.53 ft/sec

SEVERE above 13.53 ft/sec

DAMAGE PROBABILITY RED SIDE IS

NONE TO LIGHT FROM 0 ft/sec to 11.75 ft/sec

MODERATE from 11.75 ft/sec to 14.08 ft/sec

SEVERE above 14.08 ft/sec

HIT SPACE BAR TO CONTINUE.

THE CALCULATION REACHED CRITICAL CONDITIONS

ON THE RED SIDE OF THE DOWNBOUND VESSEL AT 18.05 ft/sec

DAMAGE PROBABILITY GREEN SIDE IS

NONE TO LIGHT FROM 0 ft/sec to 14.39 ft/sec

MODERATE from 14.39 ft/sec to 16.92 ft/sec

SEVERE above 16.92 ft/sec

DAMAGE PROBABILITY RED SIDE IS

NONE TO LIGHT FROM 0 ft/sec to 13.26 ft/sec

MODERATE from 13.26 ft/sec to 15.66 ft/sec

SEVERE above 15.66 ft/sec

HIT SPACE BAR TO CONTINUE.

This screen printout gives the side of the section where critical conditions were reached first. When the space bar is pressed, the results of vessel velocity and drawdown are printed on the monitor 15 lines at a time along with ranges of relative damage. They are shown by vessel direction as:

THE FOLLOWING IS A LIST OF THE RESULTS FOR
THE VELOCITY VS DRAWDOWN CALCULATIONS. THE
RESULTS WILL BE GIVEN 15 LINES AT A TIME

HIT SPACE BAR TO CONTINUE.

After pressing the space bar the screens show in order:

****** RESULTS FOR UPBOUND VESSEL ******

VESSEL VELOCITY (ft/sec)	GREEN SIDE DRAWDOWN (ft)	RED SIDE DRAWDOWN (ft)
3.00	0.03	0.03
3.50	0.04	0.04
4.00	0.05	0.04
4.50	0.07	0.05
5.00	0.08	0.07
5.50	0.09	0.08
6.00	0.11	0.09
6.50	0.13	0.11
7.00	0.15	0.13
7.50	0.17	0.14
8.00	0.20	0.17
8.50	0.23	0.19
9.00	0.26	0.21
9.50	0.30	0.24
10.00	0.34	0.27

HIT SPACE BAR TO CONTINUE.

****** RESULTS FOR UPBOUND VESSEL (cont'd) ******

VESSEL VELOCITY (ft/sec)	GREEN SIDE DRAWDOWN (ft)	RED SIDE DRAWDOWN (ft)
10.50	0.38	0.31
11.00	0.43	0.35
11.50	0.49	0.39
12.00	0.56	0.44
12.50	0.65	0.50
13.00	0.74	0.57
13.50	0.86	0.65
14.00	1.01	0.74
14.50	1.22	0.85
15.00	1.55	0.99
15.05	1.59	1.01
15.10	1.64	1.02
15.15	1.70	1.04
15.20	1.76	1.06
15.25	1.83	1.08

HIT SPACE BAR TO CONTINUE.

****** RESULTS FOR UPBOUND VESSEL (cont'd) ******

VESSEL VELOCITY (ft/sec)	GREEN SIDE DRAWDOWN (ft)	RED SIDE DRAWDOWN (ft)
15.30	1.91	1.09
15.35	2.02	1.11
15.40	2.19	1.13
CRITICAL		

HIT SPACE BAR TO CONTINUE.

****** RESULTS FOR DOWNBOUND VESSEL ******

VESSEL VELOCITY (ft/sec)	GREEN SIDE DRAWDOWN (ft)	RED SIDE DRAWDOWN (ft)
3.00	0.01	0.01
3.50	0.01	0.01
4.00	0.02	0.02
4.50	0.02	0.02
5.00	0.03	0.03
5.50	0.04	0.04
6.00	0.05	0.05

6.50	0.06	0.06
7.00	0.07	0.07
7.50	0.08	0.09
8.00	0.10	0.10
8.50	0.12	0.12
9.00	0.13	0.14
9.50	0.15	0.16
10.00	0.18	0.18

HIT SPACE BAR TO CONTINUE.

****** RESULTS FOR DOWNBOUND VESSEL (cont'd) ******

VESSEL VELOCITY (ft/sec)	GREEN SIDE DRAWDOWN (ft)	RED SIDE DRAWDOWN (ft)
10.50	0.20	0.21
11.00	0.23	0.24
11.50	0.26	0.27
12.00	0.30	0.31
12.50	0.34	0.35
13.00	0.38	0.39
13.50	0.43	0.45
14.00	0.49	0.51
14.50	0.55	0.58
15.00	0.63	0.66
15.50	0.72	0.75
16.00	0.83	0.87
16.50	0.97	1.02
17.00	1.16	1.22
17.50	1.43	1.52

HIT SPACE BAR TO CONTINUE.

****** RESULTS FOR DOWNBOUND VESSEL (cont'd) ******

VESSEL VELOCITY (ft/sec)	GREEN SIDE DRAWDOWN (ft)	RED SIDE DRAWDOWN (ft)
18.00 CRITICAL	2.00	2.31

HIT SPACE BAR TO CONTINUE.

After all of the lists of results have been run through by depressing the space bar, the user is prompted:

DO YOU WANT A HARD COPY (Yes,No)?

If a "Yes" is entered, the user is prompted to put the printer on line. After hitting the space bar, the printout is generated as in Figures 10, 11 and 12. Figure 10 contains the parameters entered along with the side at which critical conditions occurred. Note that the soil conditions have been changed from the previous example. Figures 11 and 12 are the vessel velocities, drawdowns and damage ranges for the calculation. The three figures will be paged automatically as they are here.

A "No" for the hard copy prompt, or the end of printing, results in the prompt:

DO YOU WANT TO PLOT RESULTS ON THE SCREEN (Yes,No)?

If "Yes" is entered here the results are plotted on the monitor as shown in Figures 13, 14, 15, and 16. To move through the four plots, press any key.

NAME OF SECTION ** EXAMPLE 2

AREA ON GREEN SIDE OF UPBOUND VESSEL (sq. ft) = 16700
AREA ON RED SIDE OF UPBOUND VESSEL (sq. ft) = 19456
AREA ON GREEN SIDE OF DOWNBOUND VESSEL (sq. ft) = 18350
AREA ON RED SIDE OF DOWNBOUND VESSEL (sq. ft) = 17806
NEARSHORE GREEN - OPEN SLOPING BEACH
SOIL TYPE GREEN - COARSE TO MEDIUM SAND
NEARSHORE RED - OPEN BLUFF OR ESCARPMENT
SOIL TYPE RED - MEDIUM SAND TO SILT
PERCENTAGE ICE on green side (decimal form) = .052
PERCENTAGE ICE on red side (decimal form) = .056
WIDTH OF WATER SURFACE (ft) = 1962.5
DISTANCE TO UPBOUND VESSEL from green side (ft) = 950
DISTANCE TO DOWNBOUND VESSEL from green side (ft) = 1000
VESSEL BEAM (ft) = 75
VESSEL DRAFT (ft) = 25
RIVER VELOCITY (ft per sec.) = 1
BEGIN UPBOUND VESSEL VELOCITY (ft per sec.) = 3
BEGIN DOWNBOUND VESSEL VELOCITY (ft per sec.) = 3
DEPTH AT CENTER OF CHANNEL (ft) = 33

****

THE CALCULATION REACHED CRITICAL CONDITIONS
ON THE GREEN SIDE OF THE UPBOUND VESSEL AT 15.45 ft/sec

DAMAGE PROBABILITY GREEN SIDE IS

NONE TO LIGHT FROM 0 ft/sec to 11.96 ft/sec
MODERATE from 11.96 ft/sec to 13.53 ft/sec
SEVERE above 13.53 ft/sec

DAMAGE PROBABILITY RED SIDE IS

NONE TO LIGHT FROM 0 ft/sec to 11.75 ft/sec
MODERATE from 11.75 ft/sec to 14.08 ft/sec
SEVERE above 14.08 ft/sec

THE CALCULATION REACHED CRITICAL CONDITIONS
ON THE RED SIDE OF THE DOWNBOUND VESSEL AT 18.05 ft/sec

DAMAGE PROBABILITY GREEN SIDE IS

NONE TO LIGHT FROM 0 ft/sec to 14.39 ft/sec
MODERATE from 14.39 ft/sec to 16.92 ft/sec
SEVERE above 16.92 ft/sec

DAMAGE PROBABILITY RED SIDE IS

NONE TO LIGHT FROM 0 ft/sec to 13.26 ft/sec
MODERATE from 13.26 ft/sec to 15.66 ft/sec
SEVERE above 15.66 ft/sec

Figure 10 Example 2 Drawdown and Damage

RESULTS FOR UPBOUND VESSEL

VESSEL VELOCITY (ft/sec)	GREEN SIDE DRAWDOWN (ft)	RED SIDE DRAWDOWN (ft)
3.00	0.03	0.03
3.50	0.04	0.04
4.00	0.05	0.04
4.50	0.07	0.05
5.00	0.08	0.07
5.50	0.09	0.08
6.00	0.11	0.09
6.50	0.13	0.11
7.00	0.15	0.13
7.50	0.17	0.14
8.00	0.20	0.17
8.50	0.23	0.19
9.00	0.26	0.21
9.50	0.30	0.24
10.00	0.34	0.27
10.50	0.38	0.31
11.00	0.43	0.35
11.50	0.49	0.39
12.00	0.56	0.44
12.50	0.65	0.50
13.00	0.74	0.57
13.50	0.86	0.65
14.00	1.01	0.74
14.50	1.22	0.85
15.00	1.55	0.99
15.05	1.59	1.01
15.10	1.64	1.02
15.15	1.70	1.04
15.20	1.76	1.06
15.25	1.83	1.08
15.30	1.91	1.09
15.35	2.02	1.11
15.40	2.19	1.13
CRITICAL		

Figure 11 Example 2 Velocity Iteration, Upbound

RESULTS FOR DOWNBOUND VESSEL

VESSEL VELOCITY (ft/sec)	GREEN SIDE DRAWDOWN (ft)	RED SIDE DRAWDOWN (ft)
3.00	0.01	0.01
3.50	0.01	0.01
4.00	0.02	0.02
4.50	0.02	0.02
5.00	0.03	0.03
5.50	0.04	0.04
6.00	0.05	0.05
6.50	0.06	0.06
7.00	0.07	0.07
7.50	0.08	0.09
8.00	0.10	0.10
8.50	0.12	0.12
9.00	0.13	0.14
9.50	0.15	0.16
10.00	0.18	0.18
10.50	0.20	0.21
11.00	0.23	0.24
11.50	0.26	0.27
12.00	0.30	0.31
12.50	0.34	0.35
13.00	0.38	0.39
13.50	0.43	0.45
14.00	0.49	0.51
14.50	0.55	0.58
15.00	0.63	0.66
15.50	0.72	0.75
16.00	0.83	0.87
16.50	0.97	1.02
17.00	1.16	1.22
17.50	1.43	1.52
18.00	2.00	2.31
CRITICAL		

Figure 12 Velocity Iteration, Downbound

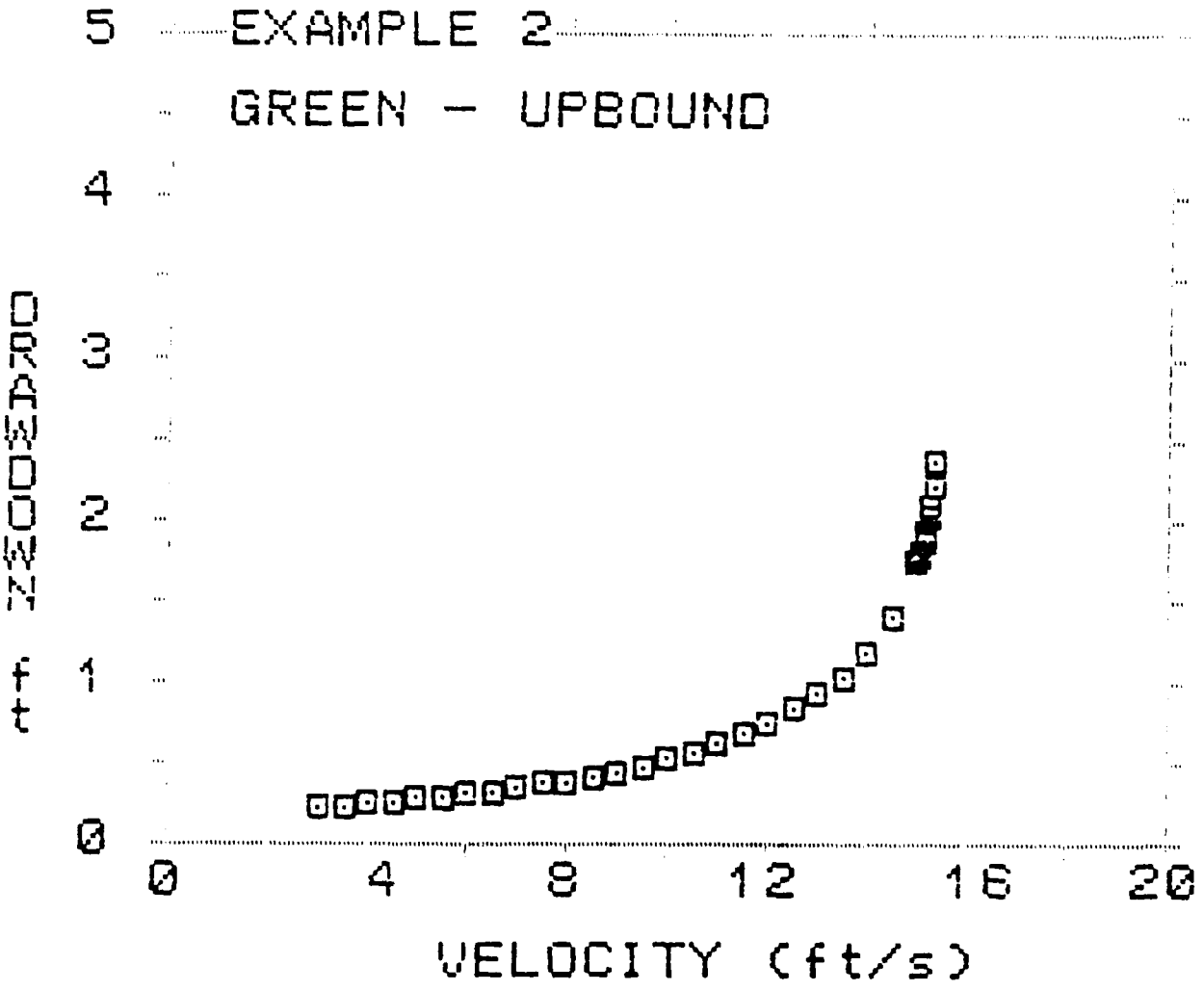


Figure 13 Screen Graphics for Green Side-Upbound Vessel

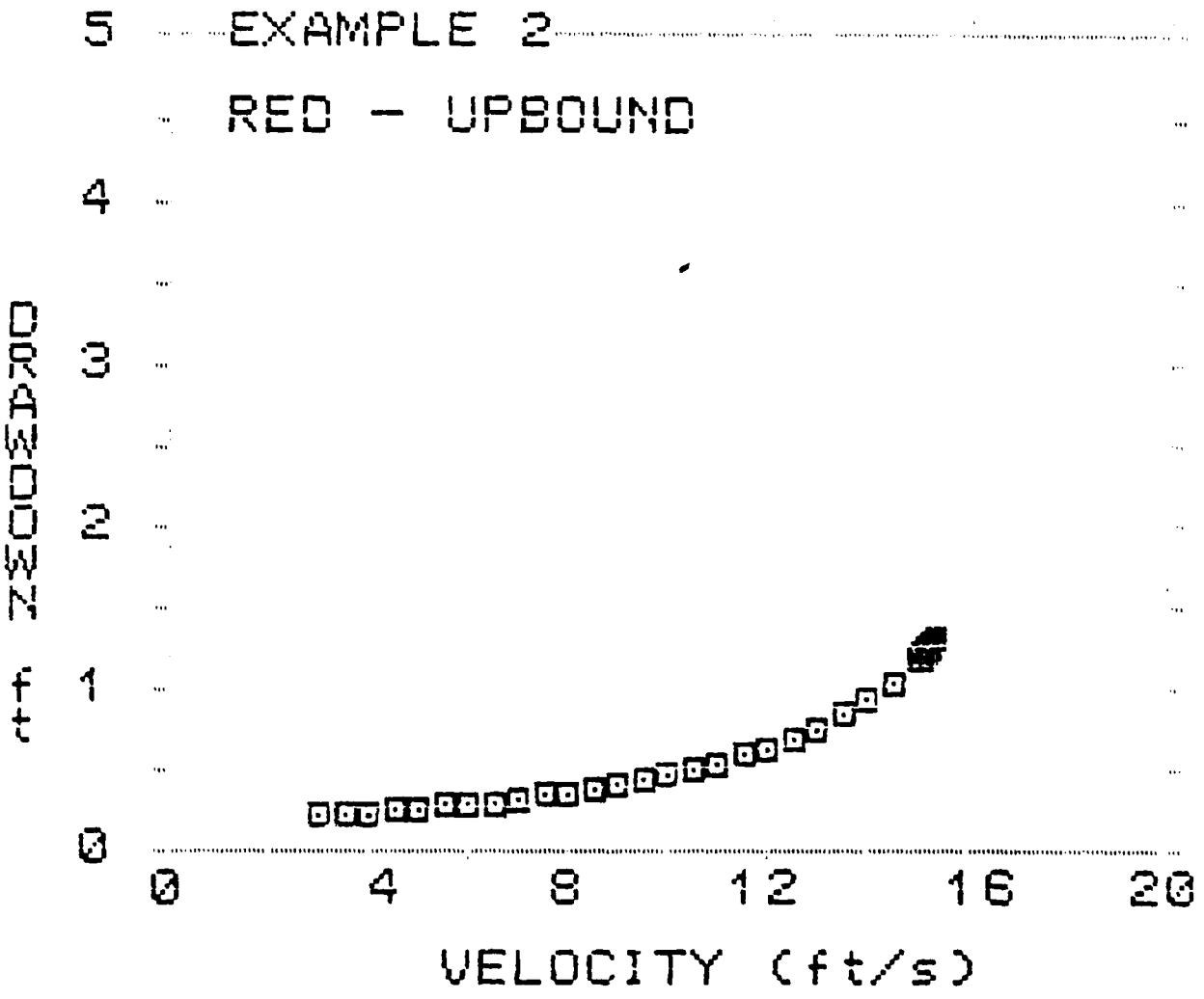


Figure 14 Screen Graphics for Red Side-Upbound Vessel

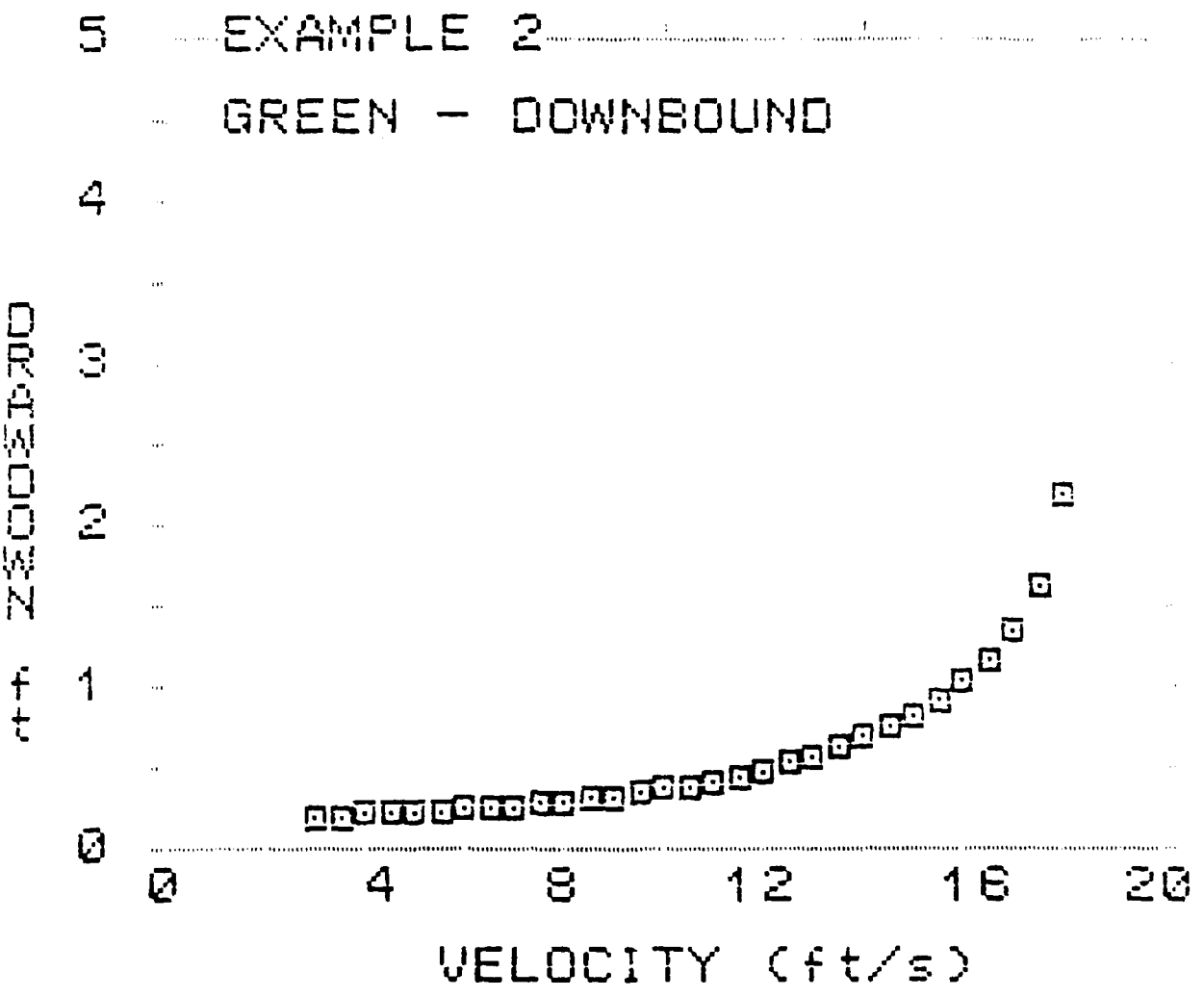


Figure 15 Screen Graphics for Green Side-Downbound Vessel

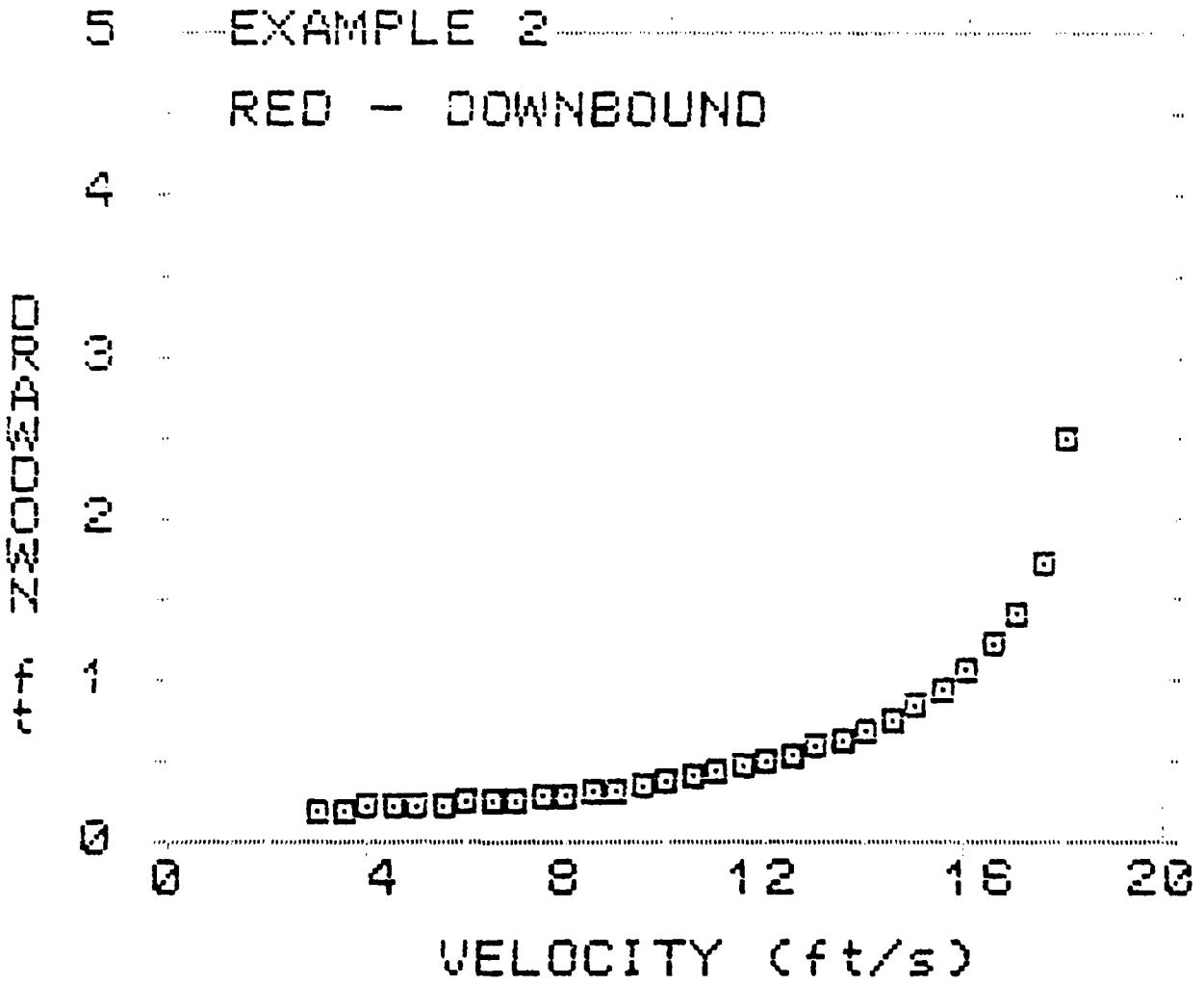


Figure 16 Screen Graphics for Red Side-Downbound Vessel

A "No" for the "plot on screen" question, or the end of the plots, results in the screen prompt:

```
DO YOU WANT TO PLOT RESULTS ON THE HP PLOTTER (Yes,No)?
```

If it is desired to plot the results on the HP plotter, a "Yes" will bring the following menu onto the screen:

```
CHOOSE ONE OF THE FOLLOWING OPTIONS

DRAW GRAPH OF

 1              DRAWDOWNS ONLY

 2              DAMAGE PROBABILITY ONLY

 3              BOTH DRAWDOWNS & DAMAGE PROBABILITY

                      INPUT OPTION  ?
```

Choose one of the plotting options and the next menu is:

```
CHOOSE ONE OF THE FOLLOWING OPTIONS

DRAW GRAPH OF

 1              GREEN SIDE ONLY

 2              RED SIDE ONLY

 3              BOTH SIDES ON SAME GRAPH

                      INPUT OPTION  ?
```

Pick the option for the side or sides desired and the computer prompts the user to:

```
PUT PLOTTER ON LINE - REPLACE PAPER

INSERT THICK BLACK PEN FOR PEN #1

INSERT FINE BLACK PEN FOR PEN #2


HIT SPACE BAR TO CONTINUE.
```

Load the paper and insert the pens and the plotting will begin. In the middle of the plot the plotter stops and the screen prompts the user:

WHEN PLOTTER PAUSES -

INSERT GREEN PEN FOR PEN #1

INSERT RED PEN FOR PEN #2

HIT SPACE BAR TO CONTINUE.

Be sure that plotting has stopped before replacing the pens. After pressing the space bar, the plot is completed. The next prompt is:

DO YOU WANT TO DRAW MORE GRAPHS (Yes,No)?

If graphs for both upbound and downbound vessels were required, this prompt would appear after two graphs had been produced.

If it is desired to make another plot, the user is returned to the first plotting menu and the same procedure is followed.

Figures 17 through 28 show all possible combinations of graphs generated by the plotting options for both upbound and downbound vessels.

A "No" at this point or "No" for the first HP plotter prompt results in the following prompt:

DO YOU WANT TO CHANGE ANY PARAMETERS AND RERUN (Yes,No)?

At this point, the user is taken into the same routine for changing parameters as in Option 2 except for the vessel velocity questions. Parameters are changed in the same fashion.

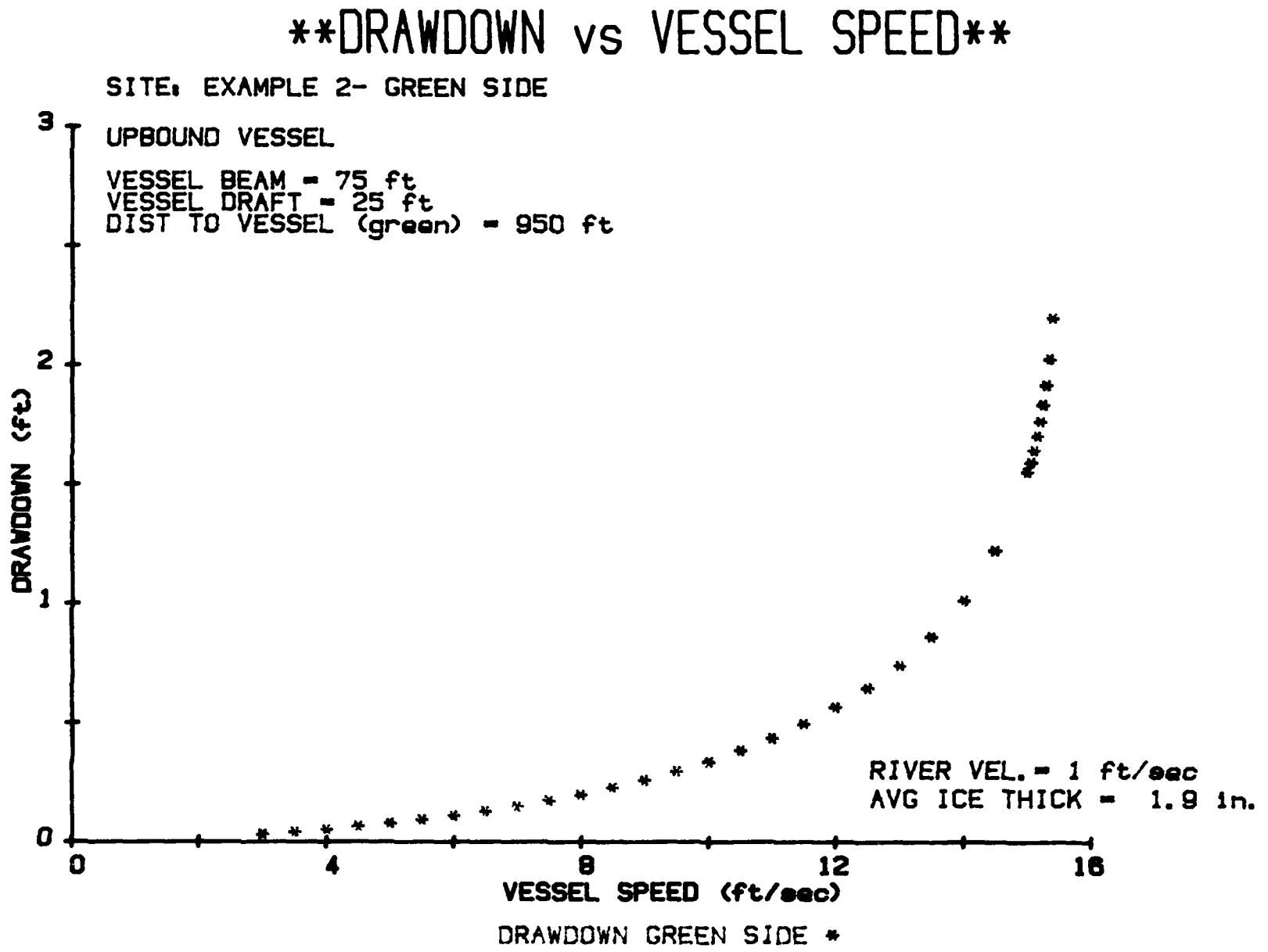


Figure 17 Drawdown for Green Side - Upbound Vessel

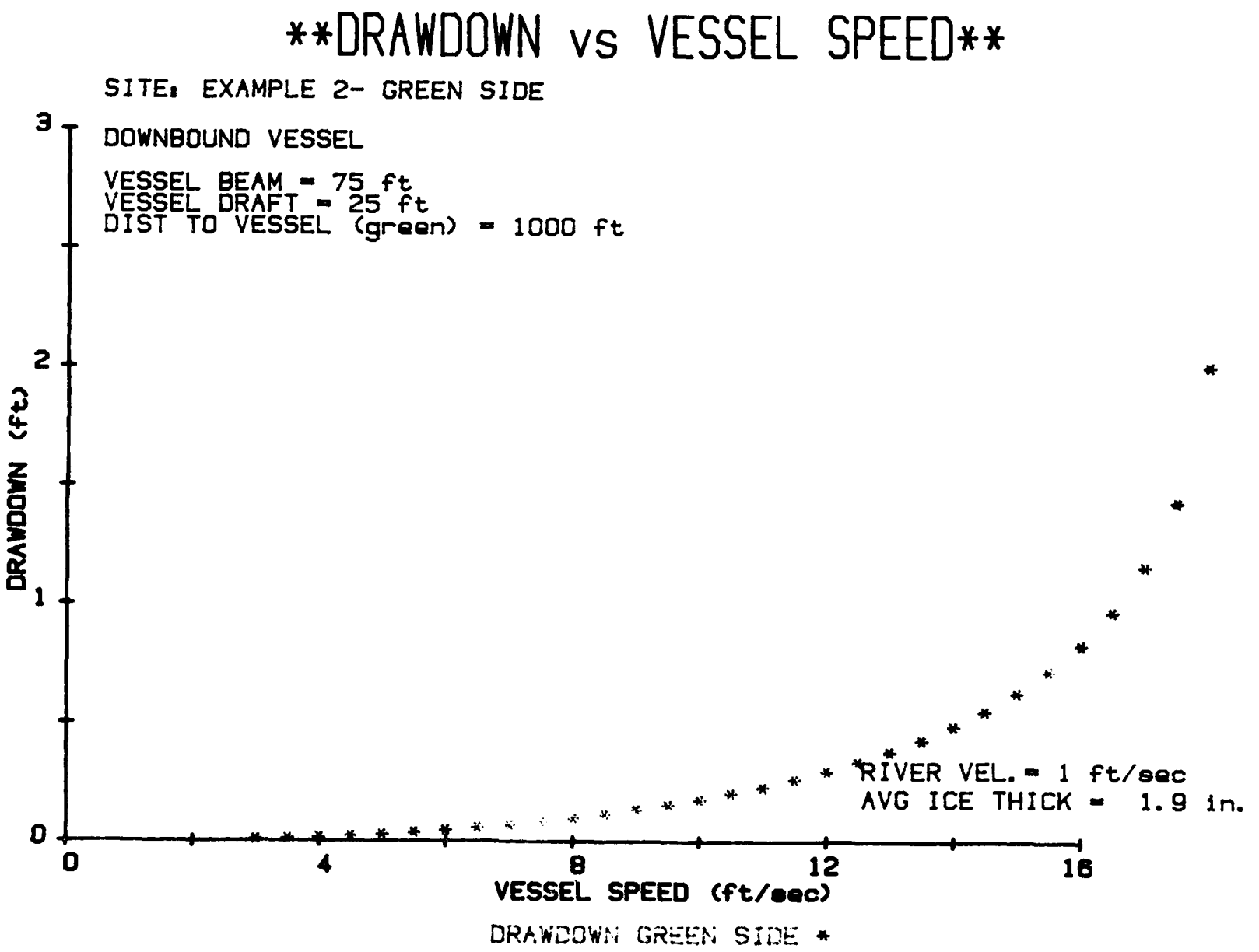


Figure 18 Drawdown for Green Side - Downbound Vessel

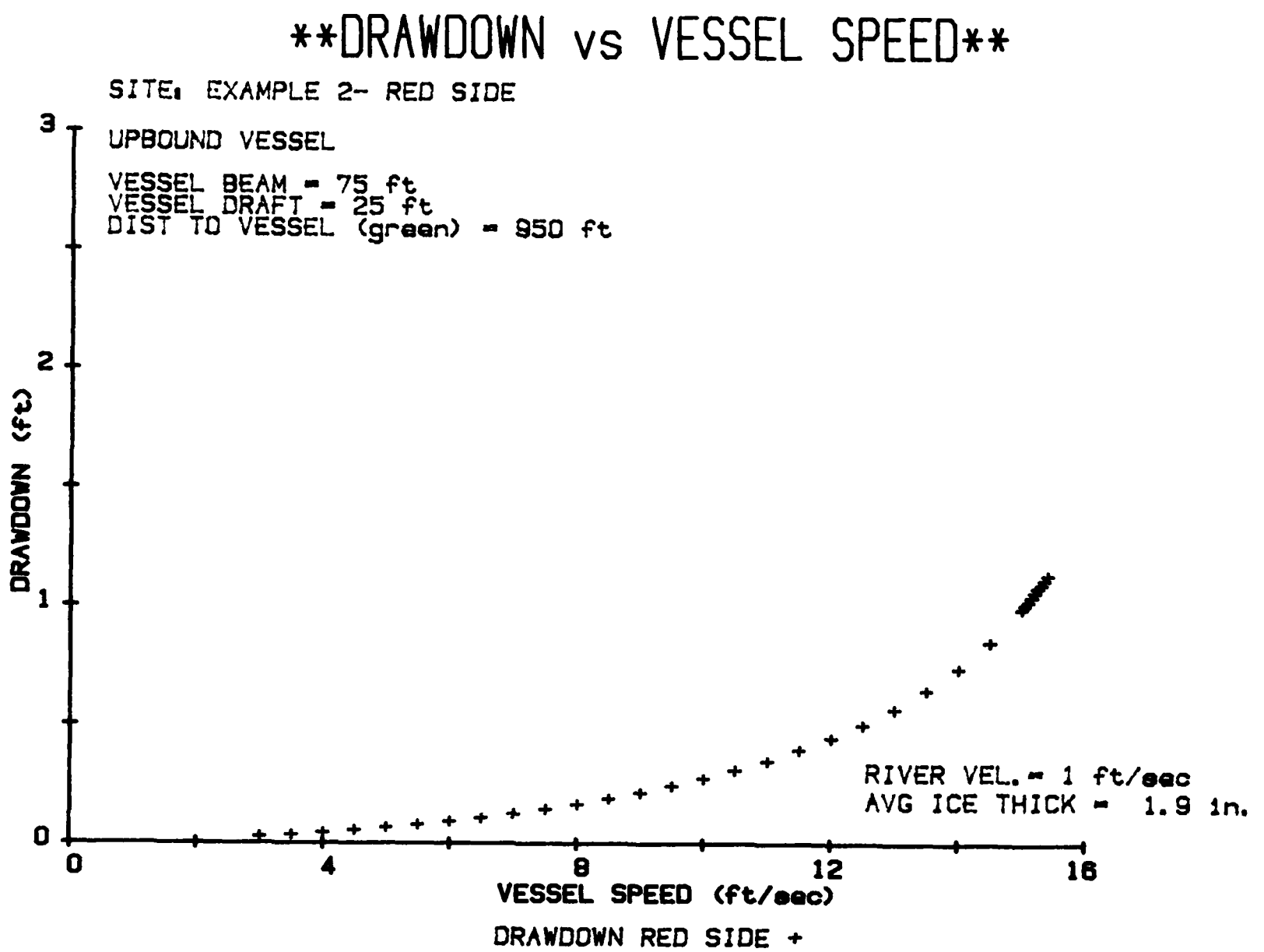


Figure 19 Drawdown for Red Side - Upbound Vessel

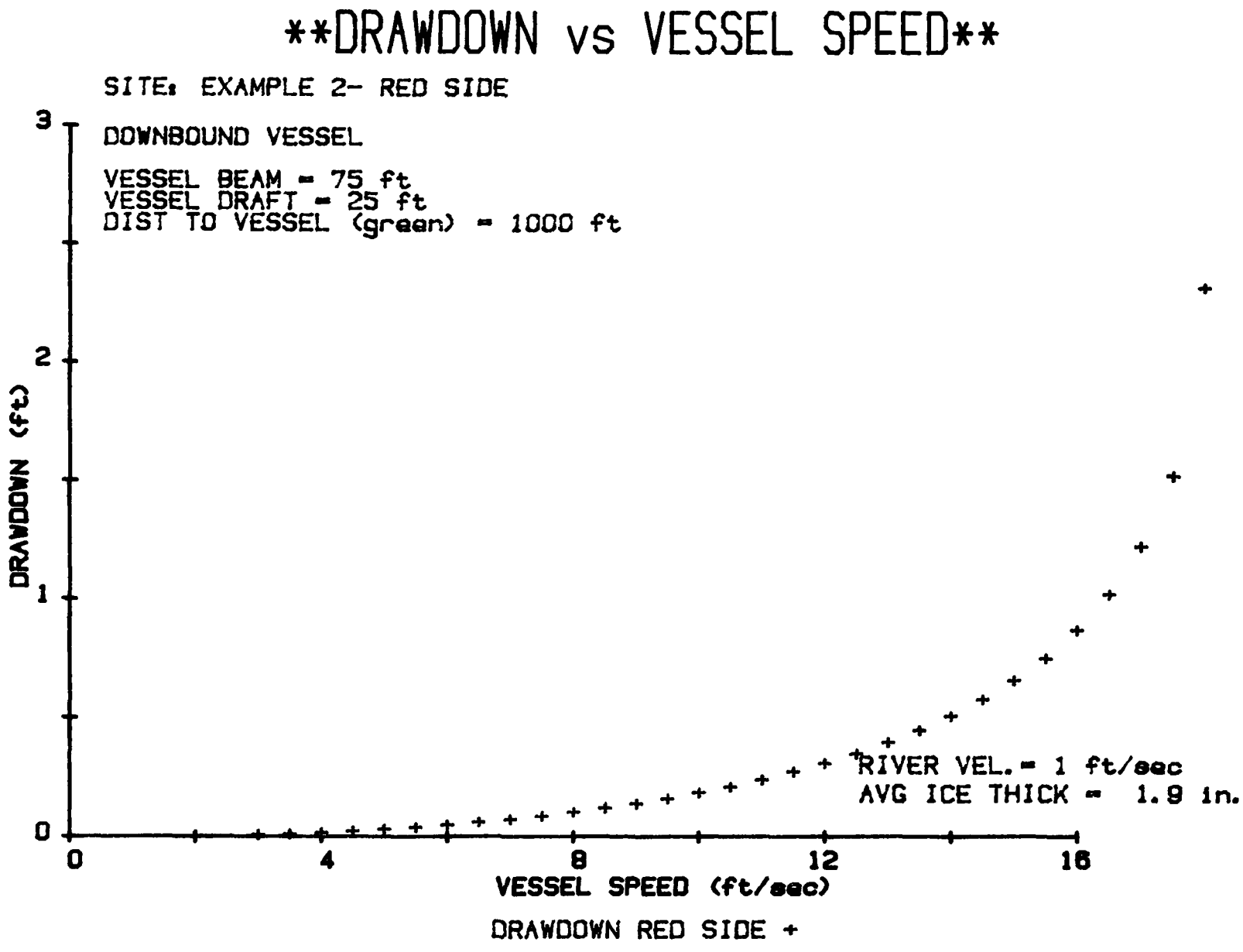


Figure 20 Drawdown for Red Side - Downbound Vessels

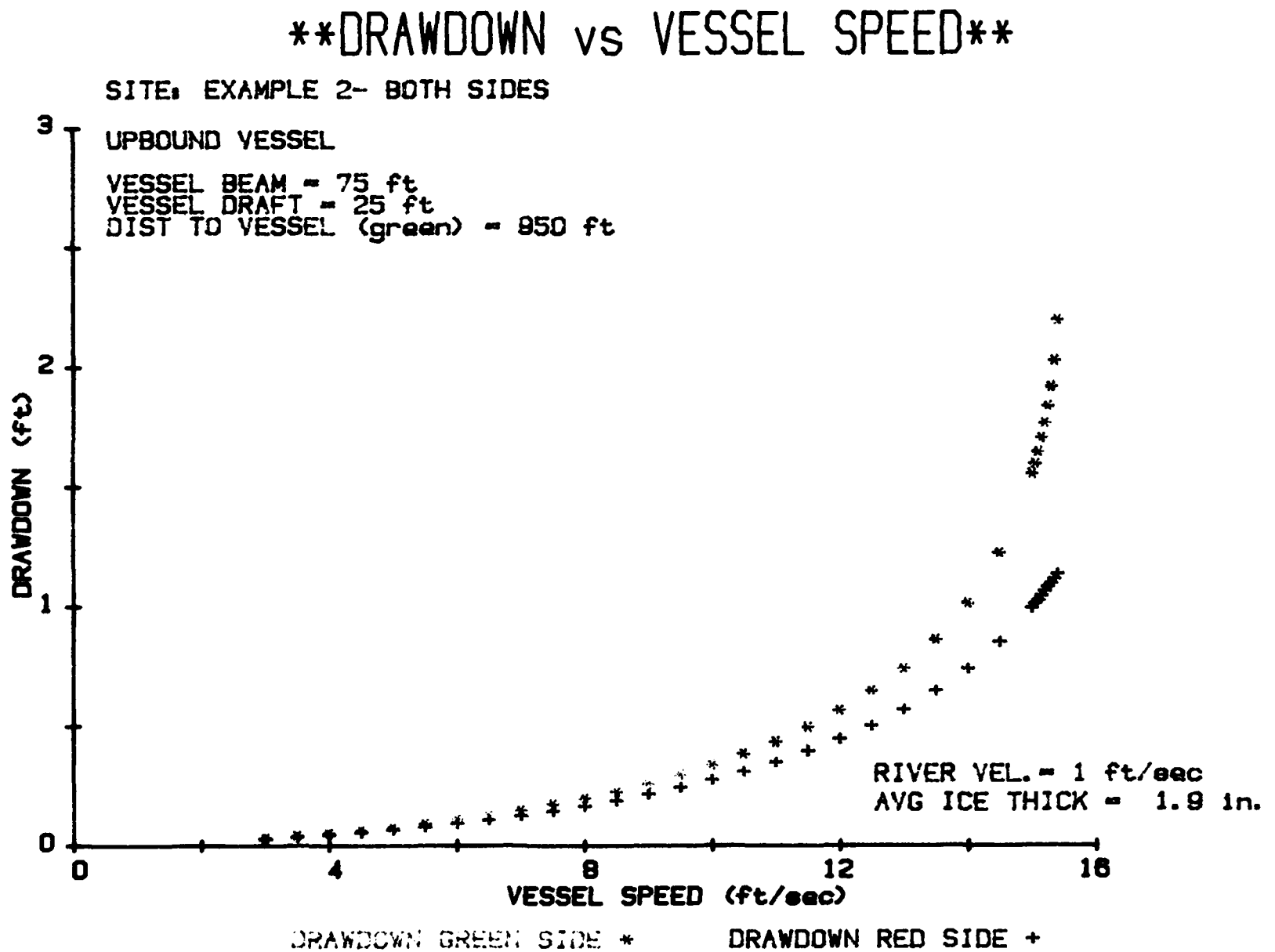


Figure 21 Drawdown for Both Sides - Upbound Vessel

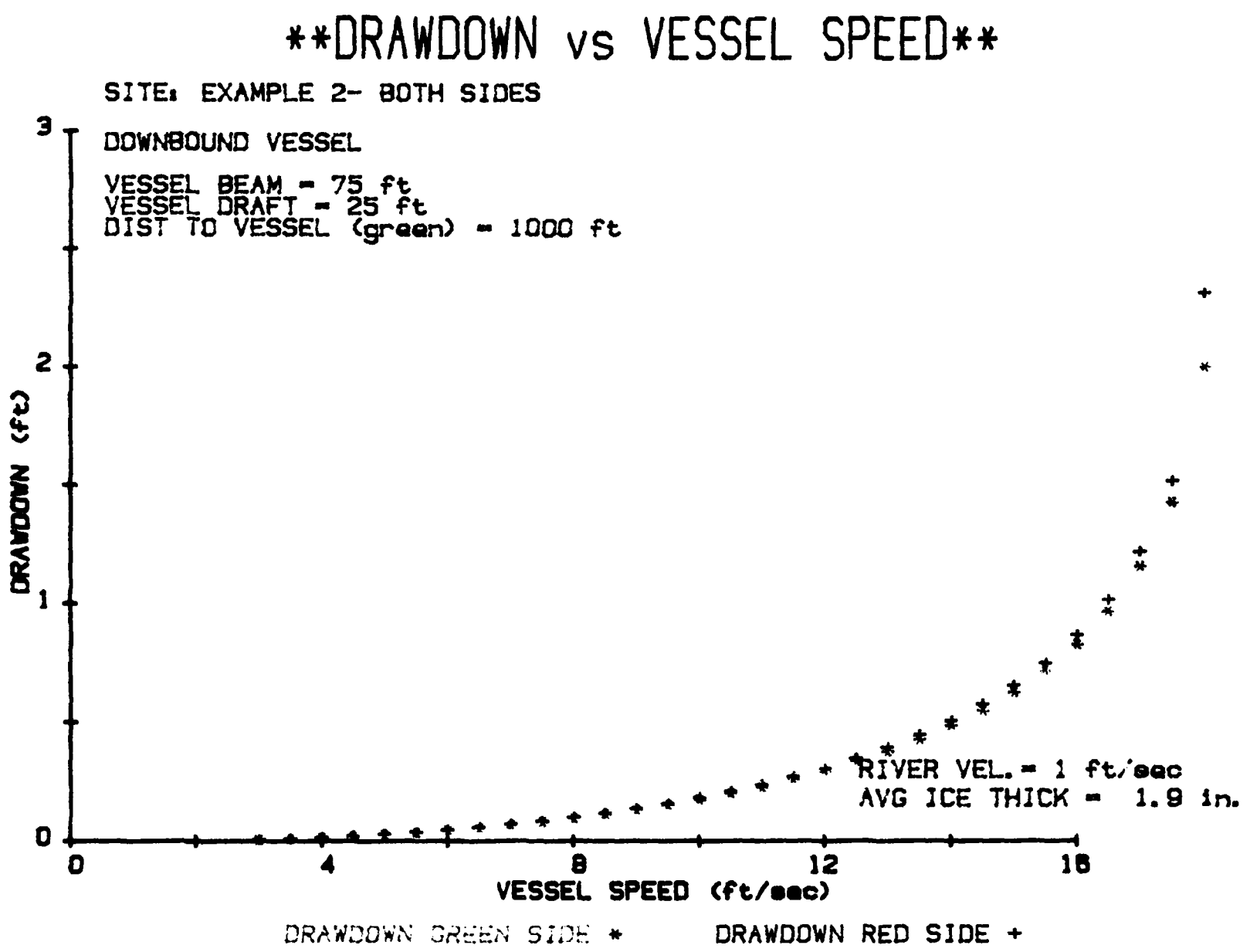


Figure 22 Drawdown for Both Sides - Downbound Vessel

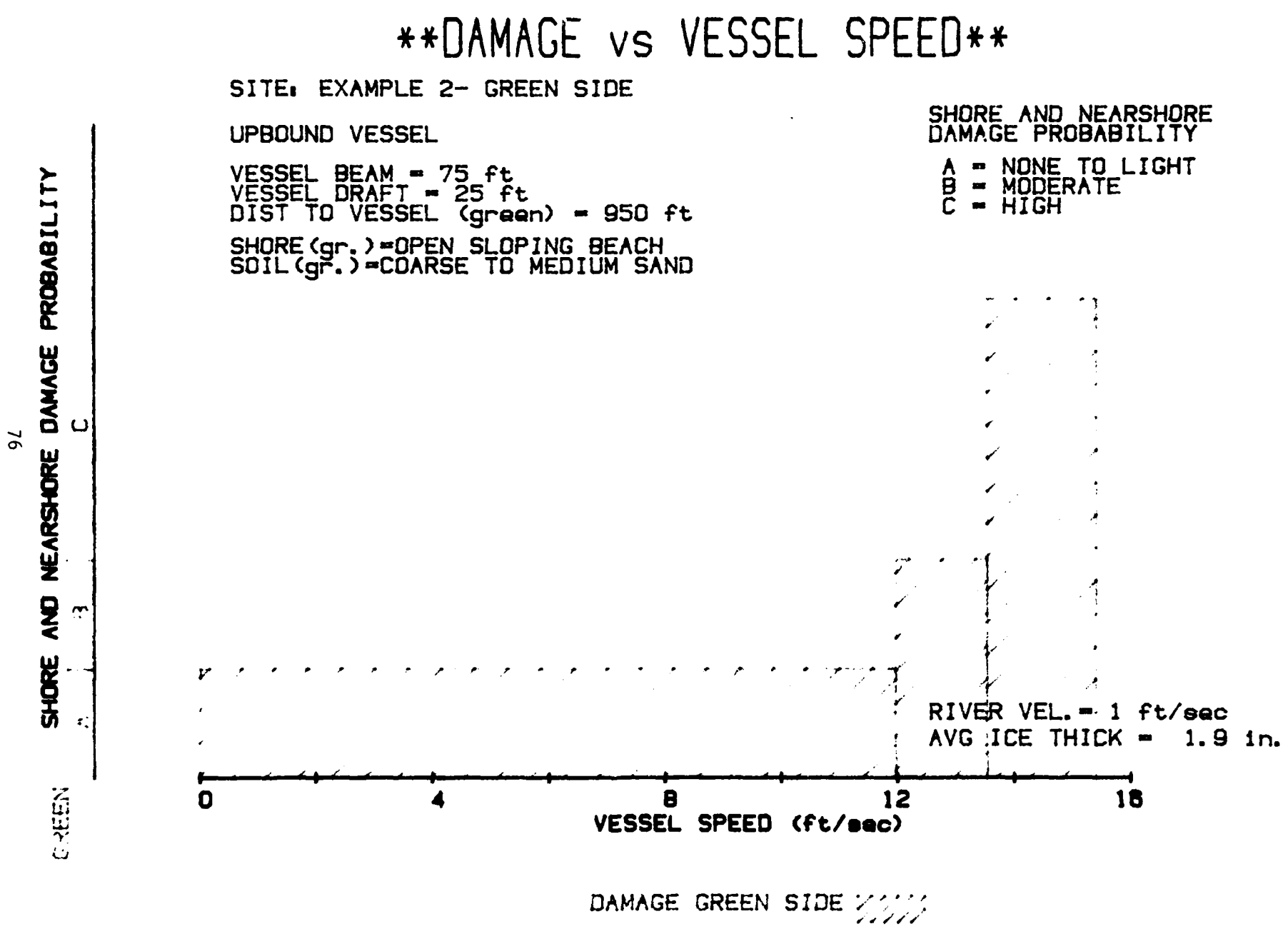


Figure 23 Damage for Green Side - Upbound Vessel

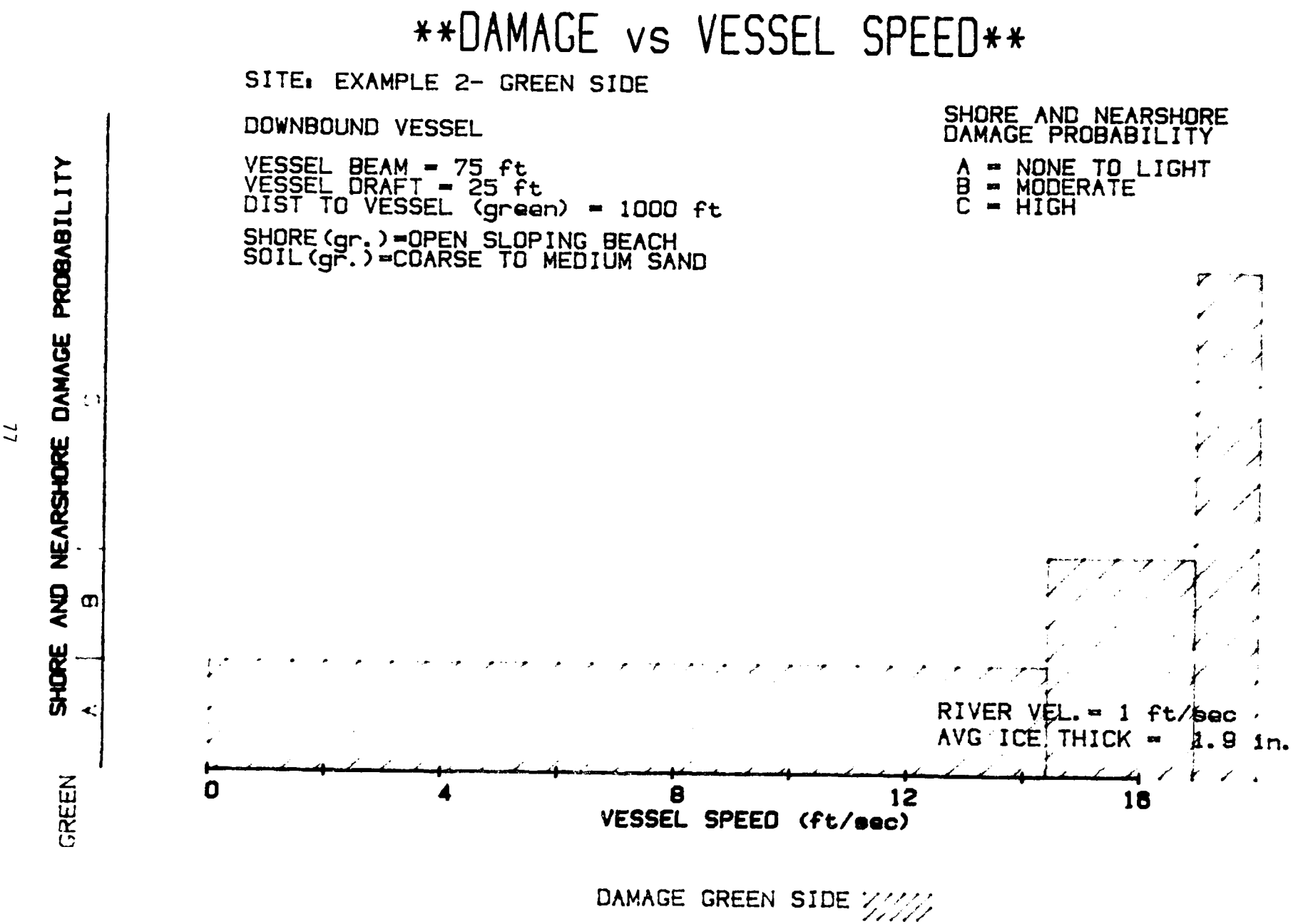
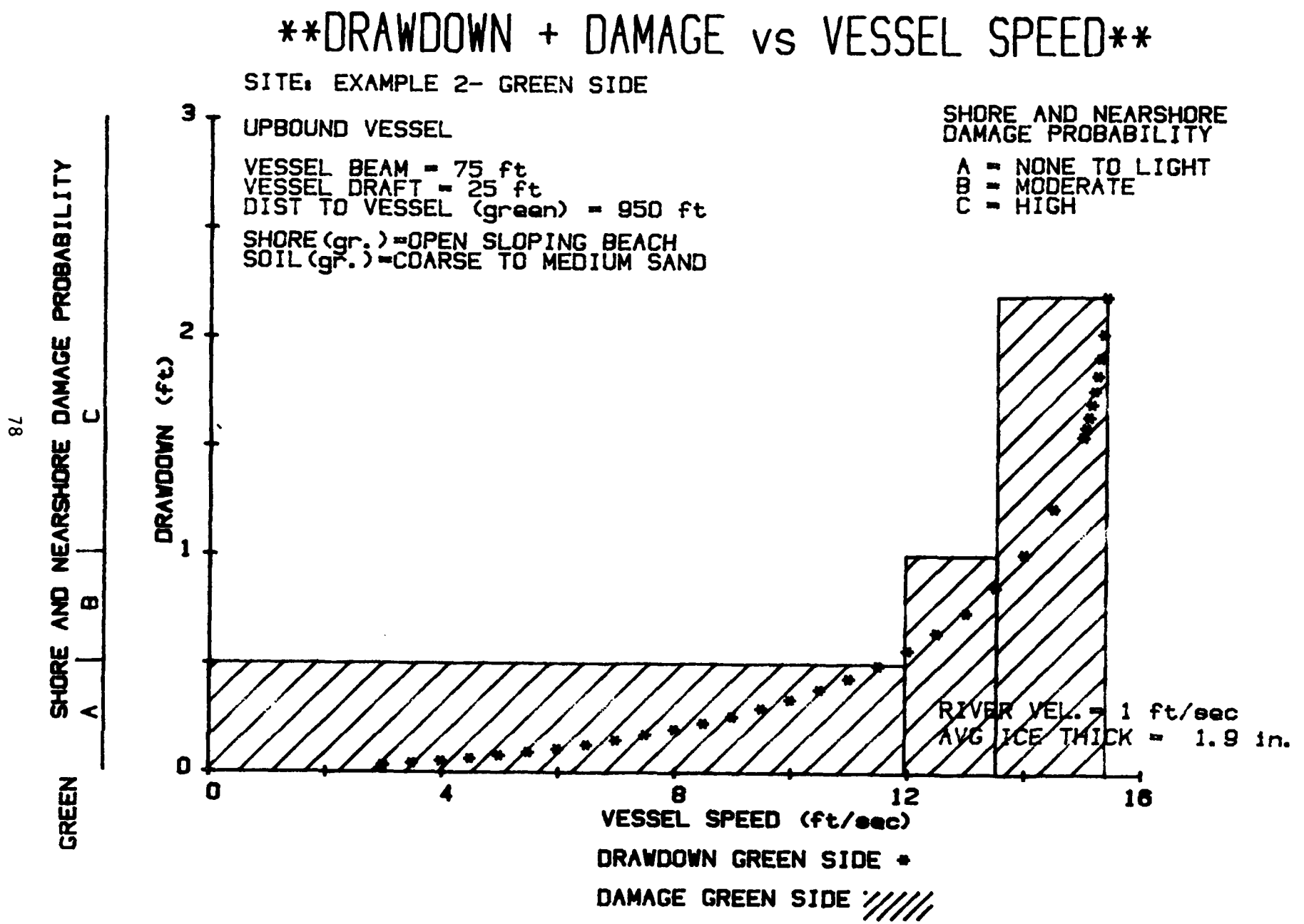


Figure 24 Damage for Green Side - Downbound Vessel


DRAWDOWN + DAMAGE vs VESSEL SPEED
SITE: EXAMPLE 2- GREEN SIDE
UPBOUND VESSEL
VESSEL BEAM = 75 ft
VESSEL DRAFT = 25 ft
DIST TO VESSEL (green) = 950 ft
SHORE(gr.)=OPEN SLOPING BEACH
SOIL(gr.)=COARSE TO MEDIUM SAND
SHORE AND NEARSHORE DAMAGE PROBABILITY
A = NONE TO LIGHT
B = MODERATE
C = HIGH
DRAWDOWN (ft)
0
1
2
3
0
4
8
12
16
VESSEL SPEED (ft/sec)
RIVER VEL. = 1 ft/sec
AVG ICE THICK = 1.9 in.
GREEN
SHORE AND NEARSHORE DAMAGE PROBABILITY
A
B
C
DRAWDOWN GREEN SIDE *
DAMAGE GREEN SIDE ////

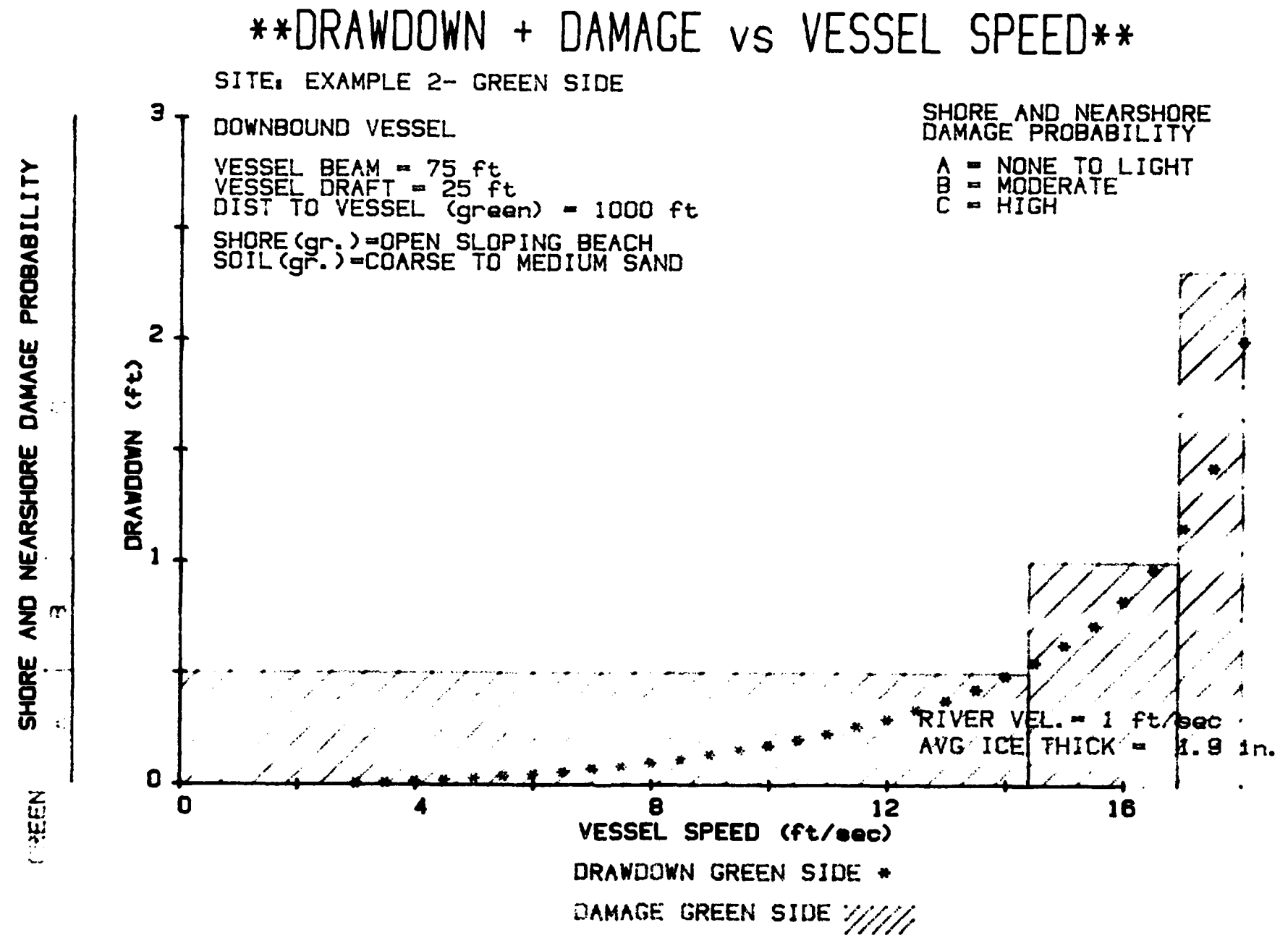


Figure 26 Drawdown and Damage for Green Side - Downbound Vessel

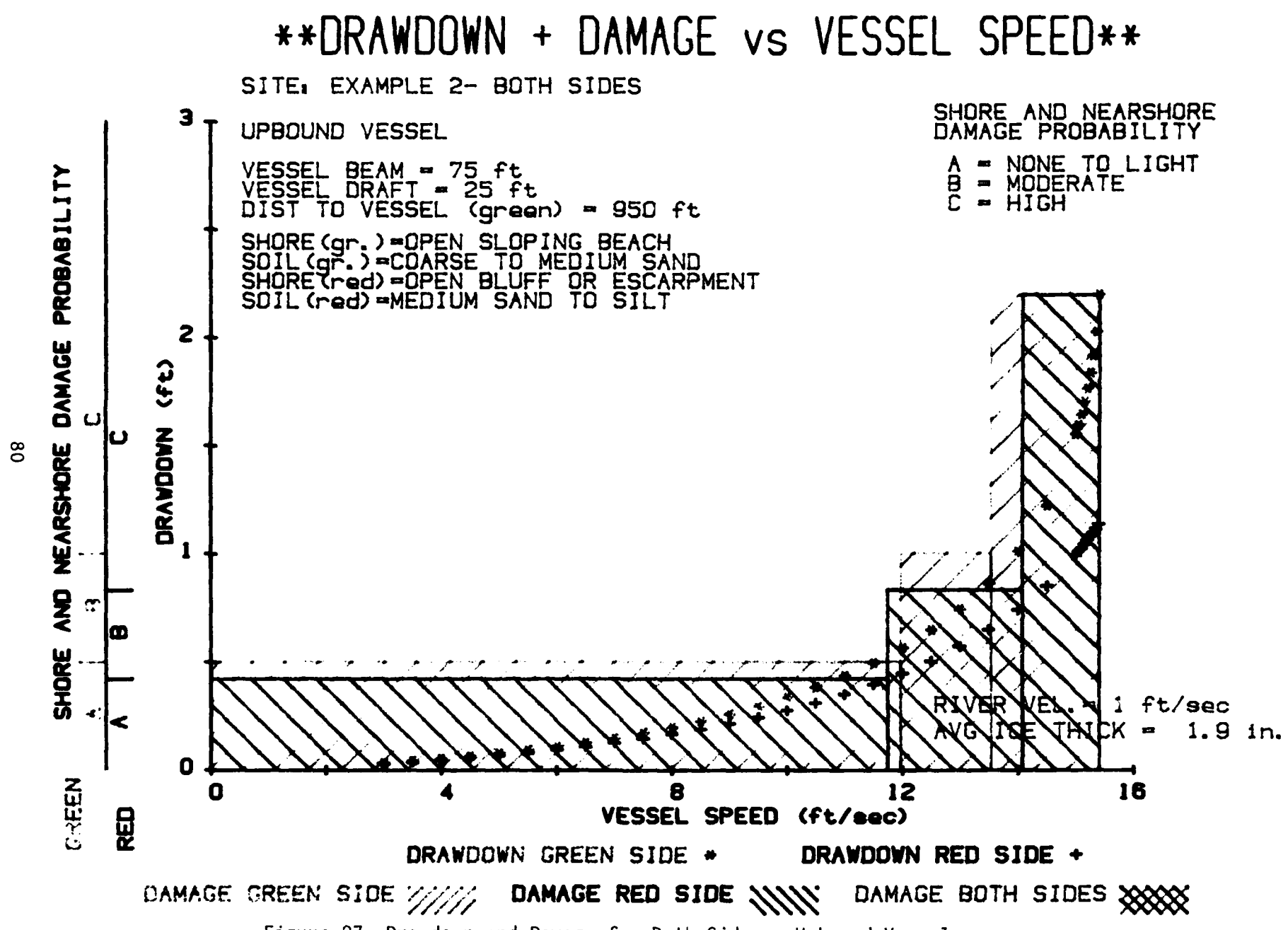


Figure 27 Drawdown and Damage for Both Sides - Upbound Vessel

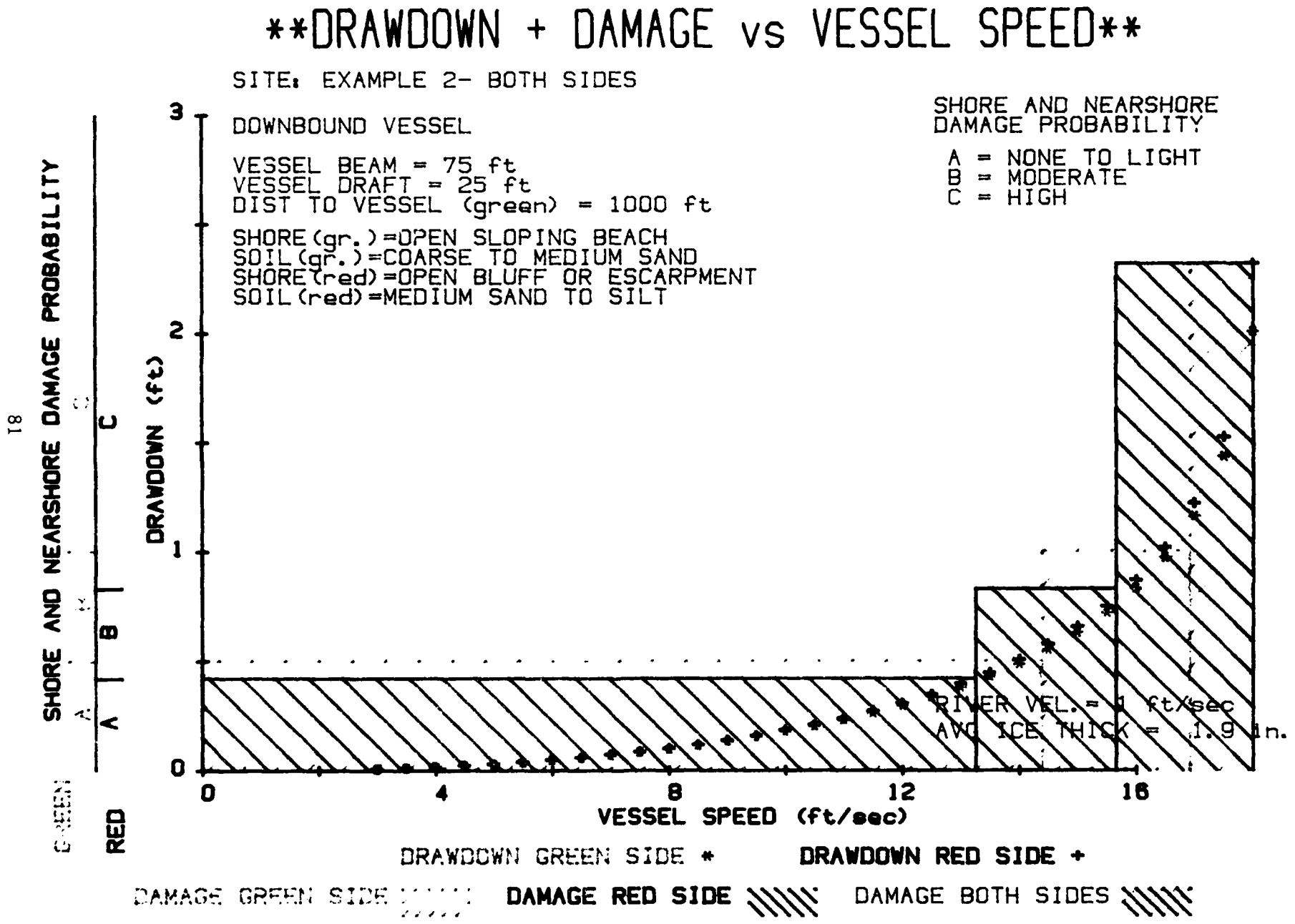


Figure 28 Drawdown and Damage for Both Sides - Downbound Vessel

The calculations portion of this routine can take several minutes. The user is requested to wait as calculations are in progress. The vessel can also become grounded as in Option 2 and the screen printout is the same.

Option 4: Fit Light Meter Data to Line and Give Results

This routine will calculate the light extinction coefficients for data stored using Option 6 of the data entry menu. The results can then be plotted on the computer screen and/or on the HP plotter.

The first text to appear on the screen is:

```
THIS ROUTINE ALLOWS FOR CALCULATION OF THE
COEFFICIENT OF EXTINCTION OF LIGHT WITH
DEPTH FOR STORED LIGHT METER DATA. IT WILL
ALSO PLOT THE RESULTS ON THE SCREEN OR ON
THE PLOTTER IF PROMPTED.

PUT DATA DISK IN DRIVE 'B'.

HIT SPACE BAR TO CONTINUE.
```

Put the data disk containing the light meter data into the drive and press the space bar.

The next prompt is for the file name of the light meter data file. The file used for this example is the same as the one entered during the description of Option 6 of the data entry menu in an earlier section. The

following text shows what appears on the screen after the file name is entered.

```
    FILE NAME?  B:LIGHT

TEST
DISTANCE =     500
OVERHEAD READING =              2000
ICE THICKNESS =                 0 in.
READING UNDER SURFACE =         1800
 1 .  2     1700
 2 .  5     1400
 3 .  10     1000
 4 .  15     700
 5 .  20     400

 END OF DATA FILE  B:LIGHT

ARE DATA CORRECT (Y/N)?
```

The prompt at the bottom, "are data correct?", is intended to allow the user to change data files if the one entered was not correct. If a "No" is entered the computer prompt is for another file name and the new file is displayed. If the data is correct and a "Yes" is entered the user is prompted to wait..while the calculation is performed. The result of the calculation as printed on the screen is as follows:

```
Ke = 0.082 +/- 0.008

NUMBER OF DATA =  4
```

END OF DATA ANALYSIS. HIT ANY KEY CONTINUE

"Ke" is the slope of the best fit line through the light data by linear regression. An explanation of its significance can be found in the main report. If no plots are to be made, this value should be recorded at this time, from the screen.

After pressing any key the prompt is:

DO YOU WANT RESULTS PLOTTED ON THE SCREEN (Y/N) ? Y

If a "Yes" is entered a representation similar to Figure 29 will show up on the screen. To clear the plot, press any key on the keyboard and the display will read:

DO YOU WANT RESULTS PLOTTED ON THE HP PLOTTER (Y/N) ?

If a "No" was entered for the computer screen plot prompt the question above would appear without the screen plot. When a plot is not desired from the HP plotter, type "No" at this time and the screen returns to the calculation menu.

If "Yes" is entered for a plot the next text is printed:

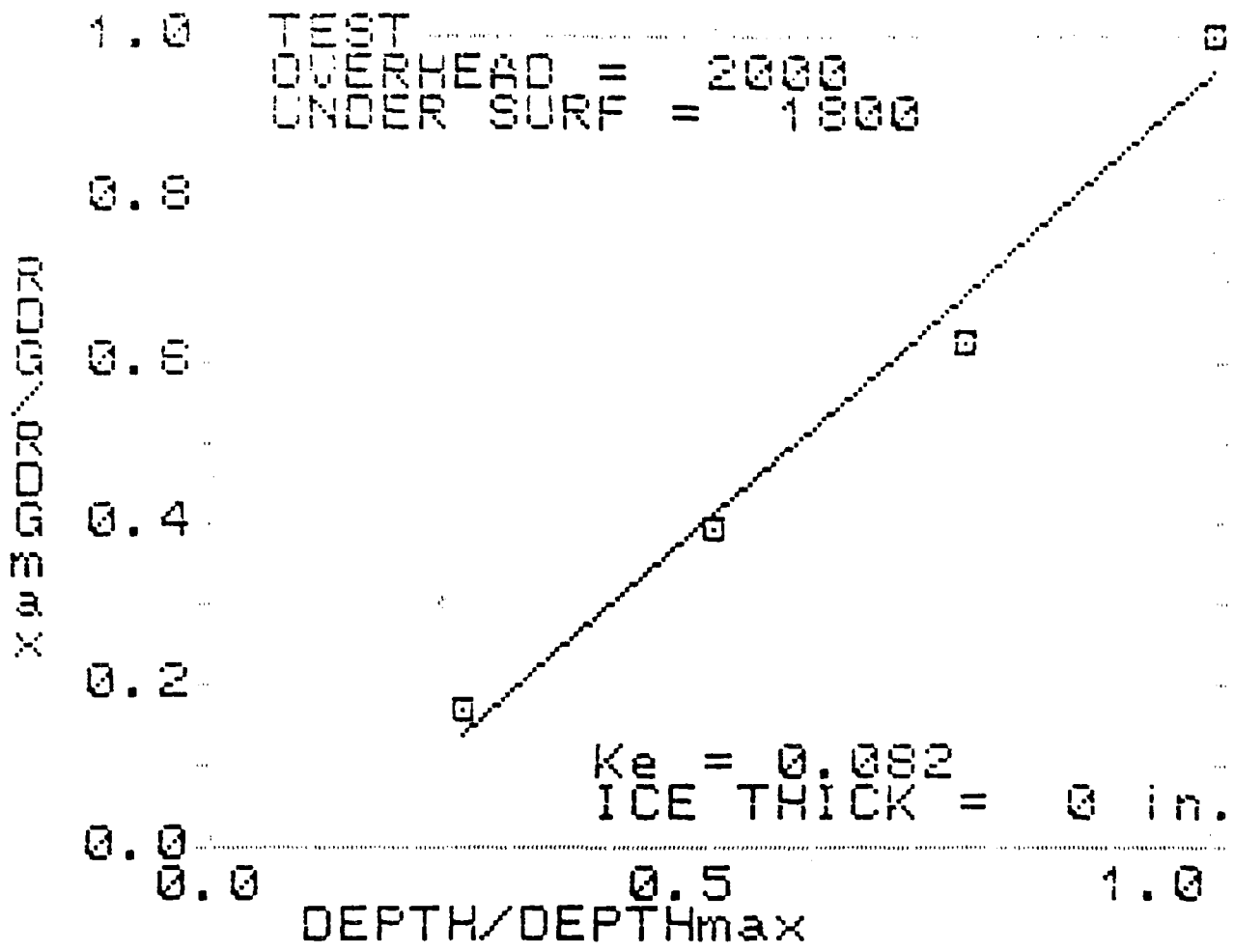


Figure 29 Screen Graphics of Light Extinction Analysis

PUT PLOTTER ON LINE

HIT SPACE BAR TO CONTINUE.

At this point, put the desired pen into the plotter, insert the 8 1/2 x 11 paper and press the space bar. Figure 30 is the result.

The last prompt is:

DO YOU WANT ANOTHER PLOT (Y/N) ?

If a "Yes" is entered the user is prompted to put the printer on line and another plot like Figure 30 results. A "No" returns the user to the calculations menu.

The previous sections are intended to familiarize the user with the various calculations subroutines. As in Option 1, MAIN PROGRAM MENU, the user can try the above examples to get an understanding of the program's use.

An explanation of the theoretical and empirical basis of this program and examples of its application can be found in the report accompanying this manual.

Listings of the various routines are found at the end of this manual.

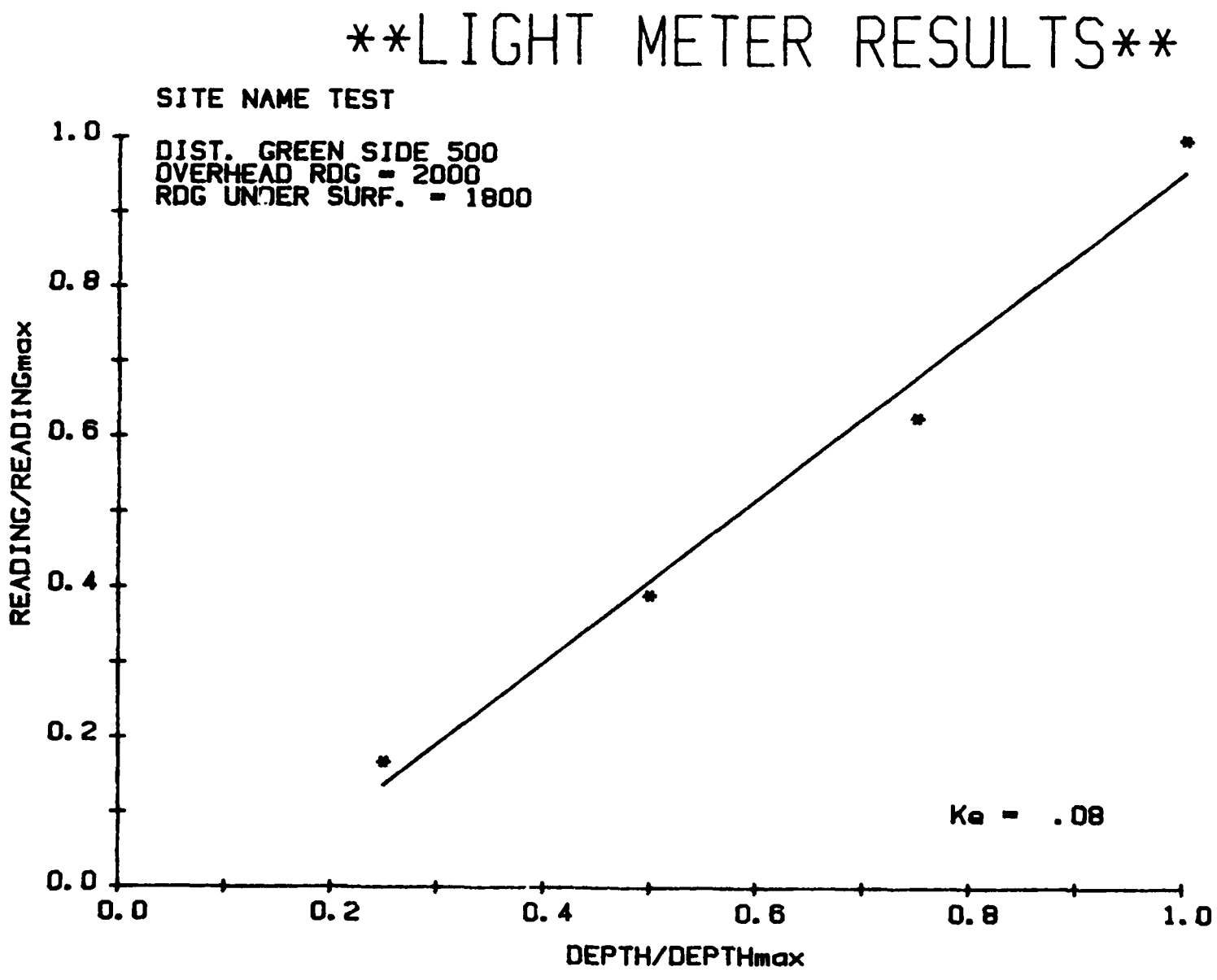


Figure 30 Light Extinction Analysis from Plotter

PROGRAM LISTING

The program is composed of five subroutines. They are BEGIN, BEGIN.TWO, TWO.SUB, ONE.SUB, and THREE.SUB. Flow diagrams are shown below and the subroutines are listed in the following sections.

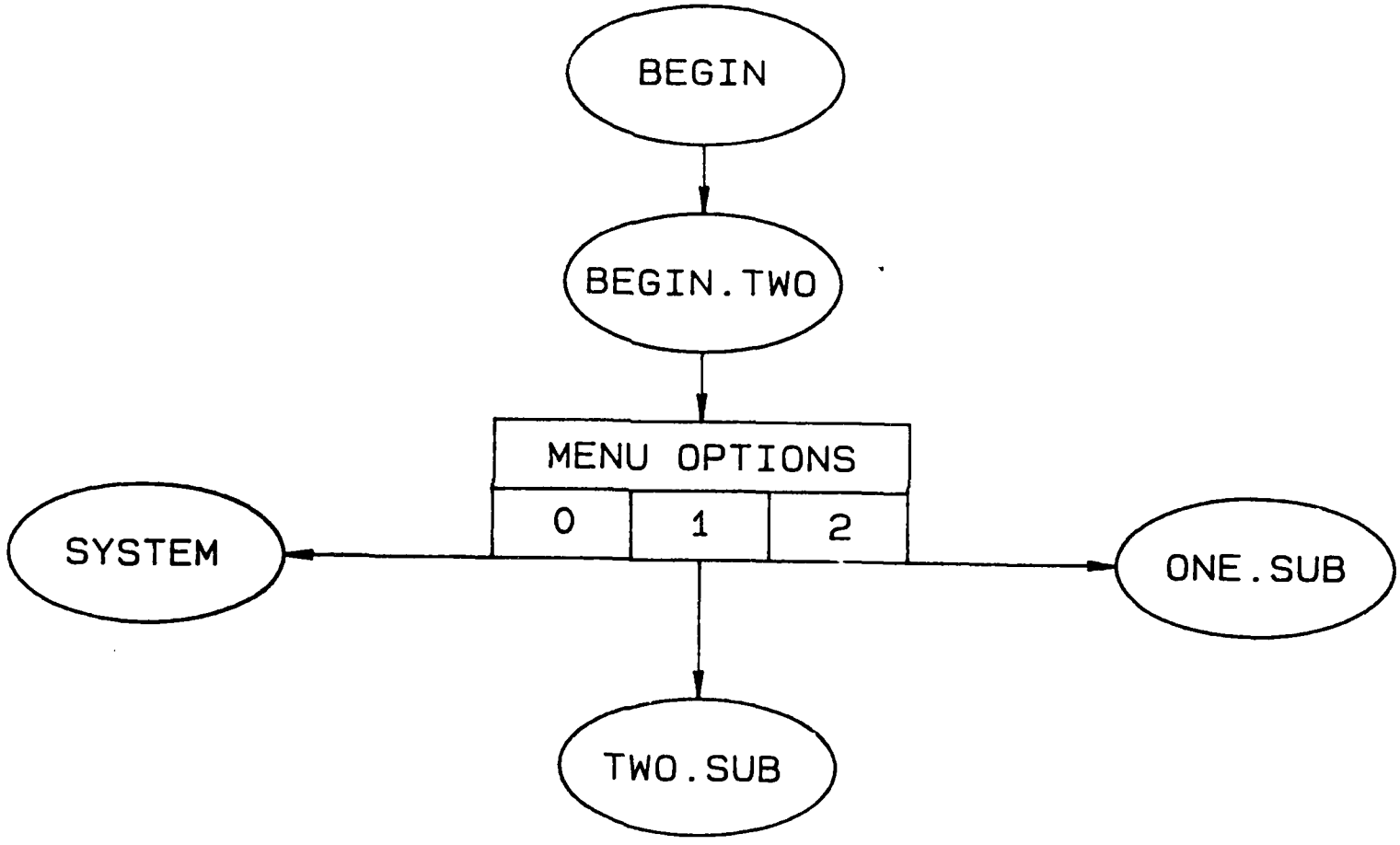


Figure 31 FLOW DIAGRAM OF STARTUP AND THE MAIN PROGRAM MENU

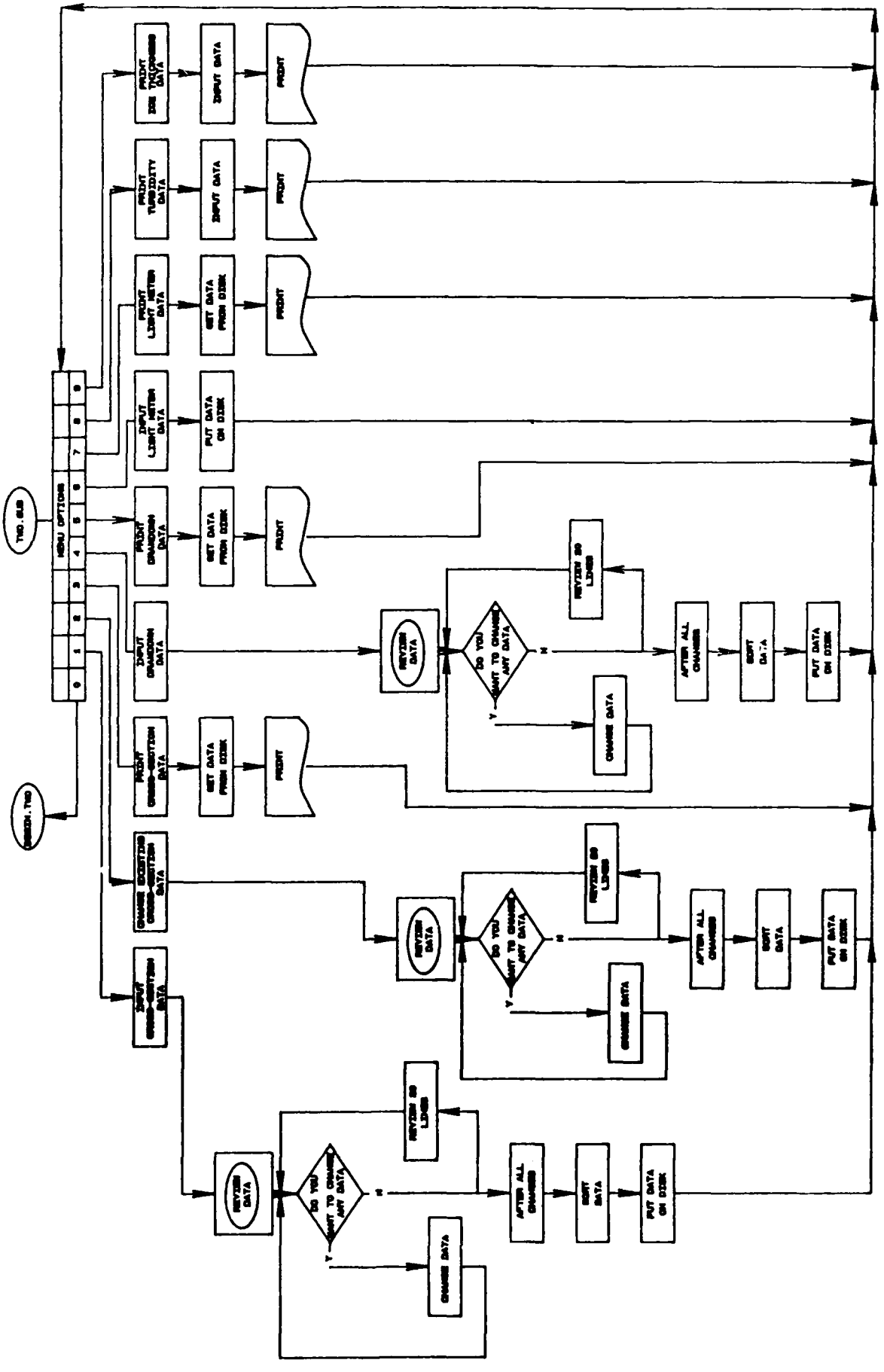


Figure 32 FLOW DIAGRAM OF TWO.SUB

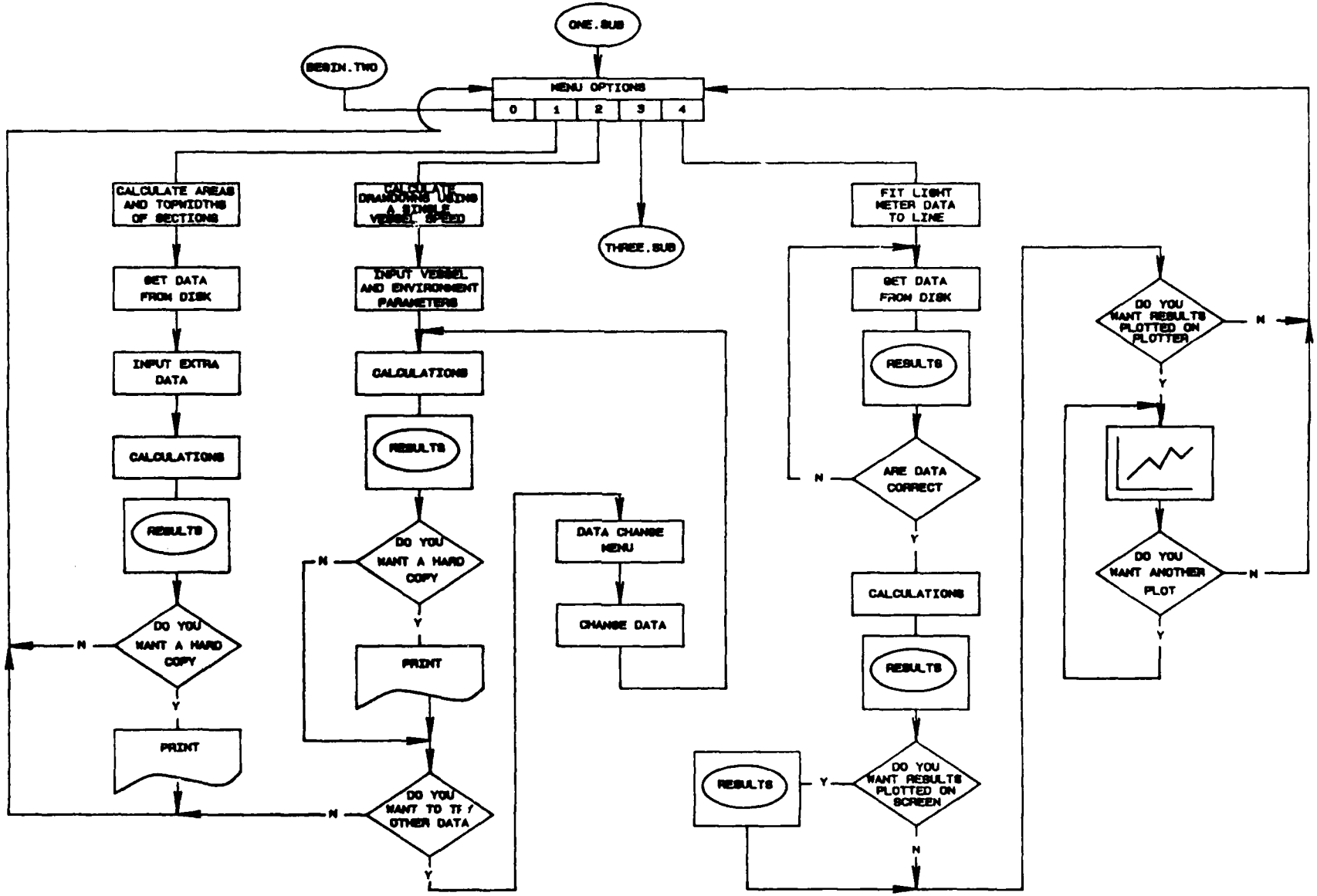


Figure 23 FLOW DIAGRAM OF ONE.SUB

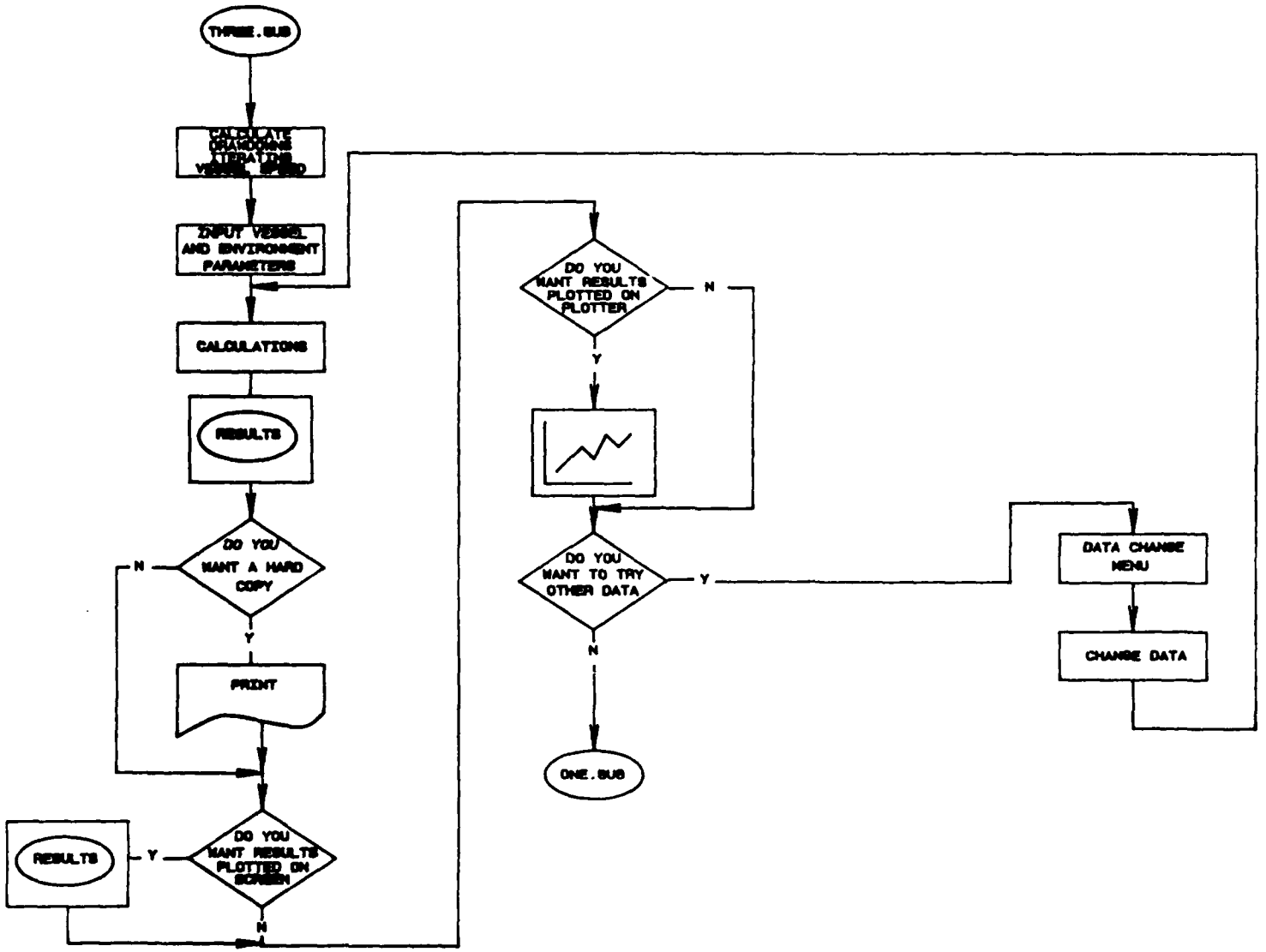


Figure 34 FLOW DIAGRAM OF THREE.SUB

BEGIN

```
100 KEY OFF
110 SCREEN 1
120 COLOR 1,3
130 CLS:PRINT :PRINT :PRINT :PRINT;PRINT :PRINT :PRINT:PRINT :PRINT
140 PRINT "          VESSEL IMPACTS IN A":PRINT :PRINT :PRINT
150 PRINT "           CONFINED WATERWAY":PRINT :PRINT :PRINT
160 FOR I=1 TO 5000:NEXT I
170 SCREEN 0 : WIDTH 80
180 CLS :PRINT :PRINT :PRINT:PRINT :PRINT
190 PRINT "             Developed by Michigan Technological University":PRINT
200 PRINT "                                    for":PRINT
210 PRINT "                        U.S. Army Corps of Engineers" :PRINT :PRINT
220 PRINT "                                    Under ":PRINT
230 PRINT "                        Contract No. DACA89-85-K-0001" :PRINT
240 PRINT "                               October 1985":PRINT :PRINT
250 PRINT :PRINT
260 PRINT "            Note: The results of this program should not be used"
270 PRINT "                  without an understanding of its companion report"
280 PRINT :PRINT
290 PRINT "                           HIT ANY KEY TO CONTINUE"
300 IF INKEY$ = "" THEN GOTO 300
310 LOAD"BEGIN.TWO",R
```

BEGIN.TWO

```
20 LPRINT:LPRINT:LPRINT:LPRINT:LPRINT:LPRINT
40 LPRINT CHR$(27);CHR$(67);CHR$(66)
60 LPRINT CHR$(27);CHR$(78);CHR$(12)
80 LLIST
100 CLS : PRINT : PRINT : PRINT
110 PRINT "                        MAIN PROGRAM OPTIONS" : PRINT
120 PRINT "          ****************************************" : PRINT : P
RINT
130 PRINT "            0    END PROGRAM EXECUTION - RETURN TO DOS" : PRINT : PR
INT
140 PRINT "            1    INPUT AND STORE FIELD DATA"
150 PRINT "                 GOTO TO PRINTER AND/OR PLOTTER " : PRINT : PRINT
160 PRINT "            2    PERFORM CALCULATIONS" : PRINT : PRINT : PRINT
170 INPUT "                              INPUT OPTION";OPT
180 IF OPT = 0 THEN GOTO 220
190 IF (OPT(1) OR (OPT)2) THEN GOTO 100
200 ON OPT GOTO 230, 240
210 GOTO 100
220 SYSTEM
230 LOAD"TWO.SUB",R
240 LOAD"ONE.SUB",R
```

TWO.SUB

```
100 KEY OFF
110 DIM T1(20),TURB7(20),T2(50),T3(50)
120 DIM X(50),Y(50),YP(50),R(50),NT(20),YPR(50),XPR(50)
130 DIM XD(50),YD(50),YPD(50),RD(50)
140 DIM XC(200),YC(200),XX(200),YY(200),I(200),J(200),YN(200)
150 DIM E(200),A(200),TC(200),DRC(200),Z(200)
160 CLS : PRINT : PRINT : PRINT
170 PRINT "                         OPTIONS"
180 PRINT "          ************************************        " : PRINT
190 PRINT "            0   RETURN TO MAIN PROGRAM MENU" : PRINT
200 PRINT "            1   INPUT CROSS-SECTION DATA" : PRINT
210 PRINT "            2   CHANGE EXISTING CROSS-SECTION DATA FILE" : PRINT
220 PRINT "            3   PRINT CROSS-SECTION DATA" : PRINT
230 PRINT "            4   INPUT FIELD DRAWDOWN DATA" : PRINT
240 PRINT "            5   PRINT FIELD DRAWDOWN DATA" : PRINT
250 PRINT "            6   INPUT LIGHT METER DATA" : PRINT
260 PRINT "            7   PRINT LIGHT METER DATA" : PRINT
270 PRINT "            8   PRINT TURBIDITY DATA" : PRINT
280 PRINT "            9   PRINT ICE THICKNESS DATA" : PRINT : PRINT
290 INPUT "                              INPUT OPTION  ";OPT
300 IF OPT=0 THEN GOTO 330
310 IF (OPT(1) OR (OPT)9) THEN GOTO 160
320 ON OPT GOTO 2830, 4020, 4810, 5270, 6400, 350, 730, 1830, 2400
330 LOAD"BEGIN.TWO",R
340 REM
350 REM INPUT DATA
360 REM
370 CLS : PRINT : PRINT
380 PRINT "  THIS ROUTINE ALLOWS FOR INPUT OF LIGHT" :PRINT
390 PRINT "  METER DATA. AFTER ALL VALUES HAVE BEEN" :PRINT
400 PRINT "  INPUT THEY WILL BE STORED ON THE DATA DISK." :PRINT
410 PRINT "  INPUT DATA AS    DEPTH,READING":PRINT
420 PRINT "  FOR EACH POINT." :PRINT :PRINT
430 PRINT "PUT DATA DISK IN DRIVE B" : PRINT
440 PRINT "HIT ANY KEY TO CONTINUE"
450 IF INKEY$ = "" THEN GOTO 450
460 CLS:PRINT :PRINT :PRINT
470 INPUT "    FILE NAME?  B:",B$
480 B$ = "B:" + B$
490 OPEN B$ FOR OUTPUT AS 1
500 PRINT :INPUT "SITE NAME ";HEAD$
510 PRINT #1, HEAD$
520 PRINT :INPUT "RDB LOCATION (dist off green side?)";HEAD2$
530 PRINT #1, HEAD2$
540 PRINT :INPUT "OVERHEAD READING ";OHR
550 PRINT #1, OHR
560 PRINT :INPUT "ICE THICKNESS in. (0 for ice free conditions) ";ITH
570 PRINT #1, ITH
```

```
580 PRINT :INPUT "READING JUST UNDER SURFACE OR ICE SHEET ";RUS
590 PRINT #1, RUS
600 I=0
610 CLS:PRINT :PRINT
620 PRINT : PRINT "ENTER DATA POINT -- DEPTH of reading ft,METER READING"
630 PRINT "INPUT -9999,0 TO FINISH DATA INPUT"
640 PRINT "DATA PAIR NO.";I+1;"=":INPUT X(I),Y(I)
650 IF X(I)=-9999 THEN GOTO 690
660 PRINT #1, X(I);Y(I)
670 I=I+1
680 GOTO 640
690 CLOSE #1
700 ND=I-1
710 GOTO 160
720 REM
730 REM PRINT DATA
740 REM
750 CLS : PRINT : PRINT
760 PRINT "PUT PRINTER ON LINE - PLACE PRINTER HEAD" : PRINT
770 PRINT "AT THE TOP OF THE PAGE" : PRINT:PRINT
780 PRINT "PUT DATA DISK IN DRIVE B" : PRINT:PRINT
790 PRINT "HIT ANY KEY TO CONTINUE"
800 IF INKEY$ = "" THEN GOTO 800
810 CLS : PRINT : PRINT
820 INPUT "    FILE NAME?  B:",B$
830 B$ = "B:" + B$
840 OPEN B$ FOR INPUT AS 1
850 INPUT #1, HEAD$
860 PRINT : PRINT HEAD$
870 INPUT #1, HEAD2$
880 PRINT "DISTANCE = ",HEAD2$
890 INPUT #1, OHR
900 PRINT "OVERHEAD READING = ",OHR
910 INPUT #1, ITH
920 PRINT "ICE THICKNESS = ",ITH ;"in."
930 INPUT #1, RUS
940 PRINT "READING UNDER SURFACE = ",RUS
950 I=0
960 INPUT #1,X(I),Y(I)
970 PRINT I+1;". ";X(I);"  ";Y(I)
980 IF EOF(1) GOTO 1010
990 I=I+1
1000 GOTO 960
1010 PRINT : PRINT " END OF DATA FILE  ";B$ : PRINT
1020 ND=I : CLOSE #1
1030 PRINT :PRINT "HIT ANY KEY TO CONTINUE"
1040 IF INKEY$ = "" THEN GOTO 1040
1050 CLS:PRINT :PRINT :PRINT
1060 PRINT : INPUT "DATE OF READINGS ";HEAD5$
1070 INPUT "TIME OF READINGS ";HEAD6$
1080 PRINT : INPUT "SKY WAS (CLEAR/CLOUDY)";HEAD3$
1090 INPUT "ICE CONDITION (NO ICE/NO SNOW/SNOWCOVERED) ";HEAD4$
1100 IF HEAD4$="SNOWCOVERED" GOTO 1120
1110 GOTO 1140
```

```
1120 INPUT "PERCENTAGE SNOW ON ICE ";PSI
1130 INPUT "DEPTH OF SNOW ON ICE (in)";DSI
1140 INPUT "TOTAL DEPTH AT LOCATION (ft) ";HEAD7$
1150 INPUT "WERE TURBIDITY SAMPLES TAKEN (Y/N)";C$
1160 IF LEFT$(C$,1) = "Y" OR LEFT$(C$,1) = "y" THEN GOTO 1180
1170 GOTO 1260
1180 J=1
1190 PRINT : INPUT "INPUT DEPTH OF SAMPLE(ft),TURBIDITY(JTU)";ZD(J),TURB(J)
1200 INPUT "MORE SAMPLES (Y/N) ";A$
1210 IF LEFT$(A$,1) = "Y" OR LEFT$(A$,1) = "y" THEN GOTO 1230
1220 GOTO 1250
1230 J=J+1
1240 GOTO 1190
1250 NZ=J
1260 CLS : PRINT : PRINT
1270 LPRINT : LPRINT : LPRINT : LPRINT : LPRINT
1280 LPRINT CHR$(27);CHR$(88);CHR$(1);CHR$(27);CHR$(87);CHR$(1);
1290 LPRINT "  @@@@@@@@@@@@@@@@@@@@@@@@@@@@@@" : LPRINT
1300 LPRINT "         LIGHT METER READINGS  " : LPRINT
1310 LPRINT "  @@@@@@@@@@@@@@@@@@@@@@@@@@@@@@" : LPRINT
1320 LPRINT CHR$(27);CHR$(87);CHR$(0)
1330 LPRINT
1340 LPRINT "     SITE NAME ",HEAD$
1350 LPRINT "     READING LOCATION (dist. from green side ft) ",HEAD2$ : LPRINT
1360 LPRINT "     DATE ",HEAD5$
1370 LPRINT "     TIME ",HEAD6$
1380 LPRINT "     SKY WAS ",HEAD3$
1390 IF HEAD4$="NO ICE" GOTO 1460
1400 LPRINT "     ICE CONDITION ",HEAD4$
1410 IF HEAD4$="SNOWCOVERED" GOTO 1430
1420 GOTO 1450
1430 LPRINT "     PERCENTAGE SNOW ON ICE ",PSI
1440 LPRINT "     DEPTH OF SNOW ON ICE (in) ",DSI
1450 LPRINT "     ICE THICKNESS (in) ",ITH
1460 LPRINT "     TOTAL DEPTH AT LOCATION (ft) ",HEAD7$ : LPRINT
1470 LPRINT "     OVERHEAD LIGHT READING ",OHR
1480 IF HEAD4$="NO ICE" GOTO 1510
1490 LPRINT "     LIGHT READING JUST UNDER ICE ",RUG
1500 GOTO 1520
1510 LPRINT "     LIGHT READING JUST UNDER WATER SURFACE ",RUG
1520 J=1
1530 IF LEFT$(C$,1) = "Y" OR LEFT$(C$,1) = "y" THEN GOTO 1620
1540 LPRINT
1550 LPRINT "            DEPTH OF          LIGHT METER "
1560 LPRINT "        *** READING ***      *** READING *** " : LPRINT
1570 FOR I=0 TO ND
1580 LPRINT USING "           ##.#    ";X(I);
1590 LPRINT USING "         ####.##";Y(I)
1600 NEXT I
1610 GOTO 160
1620 LPRINT
1630 LPRINT "            DEPTH OF        LIGHT METER     TURBIDITY "
1640 LPRINT "       *** READING(ft) *** *** READING *** *** (JTU) *** " : LPRINT
1650 FOR I=0 TO ND
```

```
1660 IF X(I)<ZD(J) GOTO 1780
1670 IF X(I)=ZD(J) GOTO 1730
1680 IF J=NZ+1 GOTO 1780
1690 LPRINT USING "             ##.#  ";ZD(J);
1700 LPRINT USING "                          ##.## ";TURB(J)
1710 J=J+1
1720 GOTO 1660
1730 LPRINT USING "             ##.#     ";X(I);
1740 LPRINT USING "       ####.## ";Y(I);
1750 LPRINT USING "         ##.## ";TURB(J)
1760 J=J+1
1770 GOTO 1800
1780 LPRINT USING "             ##.#     ";X(I);
1790 LPRINT USING "       ####.## ";Y(I)
1800 NEXT I
1810 GOTO 160
1820 REM
1830 REM PRINTOUT FOR TURBIDITIES
1840 REM
1850 CLS : PRINT : PRINT : PRINT
1860 PRINT "  PUT PRINTER ON LINE - PLACE PRINTER HEAD" : PRINT
1870 PRINT "  AT THE TOP OF THE PAGE" : PRINT:PRINT
1880 PRINT "              HIT SPACE BAR TO CONTINUE."
1890 Q$=INKEY$: IF Q$<> " " THEN GOTO 1890
1900 K=1
1910 CLS : PRINT : PRINT : PRINT
1920 PRINT : INPUT "SITE NAME ";TURB$
1930 PRINT : INPUT "DATE OF READINGS ";TURB5$
1940 PRINT : INPUT "NUMBER OF SAMPLING LOCATIONS";JT
1950 J=1
1960 CLS : PRINT : PRINT : PRINT
1970 PRINT : PRINT "DISTANCE TO LOCATION ";J;"(from green side in feet)" : INPUT
 T1(J)
1980 PRINT : PRINT "TOTAL DEPTH AT LOCATION ";J;"(ft) " : INPUT TURB7(J)
1990 PRINT "INPUT DEPTH OF SAMPLE,TURBIDITY(JTU)" : INPUT T2(K),T3(K)
2000 PRINT "INPUT MORE DATA FOR LOCATION";J;"Y/N?" : INPUT A$
2010 IF LEFT$(A$,1) = "Y" OR LEFT$(A$,1) = "y" THEN GOTO 2030
2020 GOTO 2050
2030 K=K+1
2040 GOTO 1990
2050 NT(J)=K
2060 J=J+1
2070 IF J=JT+1 GOTO 2100
2080 K=K+1
2090 GOTO 1960
2100 CLS : PRINT : PRINT : PRINT
2110 LPRINT : LPRINT : LPRINT : LPRINT : LPRINT
2120 LPRINT CHR$(27);CHR$(88);CHR$(1);CHR$(27);CHR$(87);CHR$(1);
2130 LPRINT "  @@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@" : LPRINT
2140 LPRINT "         TURBIDITY  READINGS  " : LPRINT
2150 LPRINT "  @@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@" : LPRINT
2160 LPRINT CHR$(27);CHR$(87);CHR$(0)
2170 LPRINT
2180 LPRINT "     SITE NAME ",TURB$ : LPRINT
```

```
2190 LPRINT "     DATE ",TURB5$ : LPRINT
2200 FOR J=1 TO JT
2210 LPRINT "     TOTAL DEPTH AT LOCATION ";J;" (ft) ",TURB7(J)
2220 NEXT J
2230 LPRINT : LPRINT "     ALL DISTANCES ARE FROM THE GREEN SIDE BASELINE"
2240 LPRINT
2250 LPRINT "                    DIST. TO          DEPTH OF       TURBIDITY "
2260 LPRINT "                *** SAMPLE(ft) ***  *** SAMPLE ***  *** (JTU) ***
 " : LPRINT
2270 Z=1
2280 FOR J=1 TO JT
2290 LPRINT "     LOCATION";J;
2300 LPRINT USING "       ####.#    ";T1(J)
2310 FOR K=Z TO NT(J)
2320 LPRINT "                                    ";
2330 LPRINT USING "       ###.#    ";T2(K);
2340 LPRINT USING "         ##.## ";T3(K)
2350 NEXT K
2360 Z=NT(J)+1
2370 NEXT J
2380 GOTO 160
2390 REM
2400 REM PRINTOUT FOR ICE THICKNESS
2410 REM
2420 CLS : PRINT : PRINT : PRINT
2430 K=1
2440 PRINT "  PUT PRINTER ON LINE - PLACE PRINTER HEAD" : PRINT
2450 PRINT "  AT THE TOP OF THE PAGE" : PRINT:PRINT
2460 PRINT "              HIT SPACE BAR TO CONTINUE."
2470 Q$=INKEY$: IF Q$() " " THEN GOTO 2470
2480 CLS : PRINT : PRINT : PRINT
2490 PRINT : INPUT "SITE NAME ";ICE$
2500 PRINT : INPUT "DATE OF READINGS ";ICE1$
2510 CLS : PRINT : PRINT : PRINT
2520 PRINT : PRINT "DISTANCE TO LOCATION ";K;"(from green side in feet)" : INPUT
 T1(K)
2530 PRINT "INPUT DEPTH AT LOC.(ft),ICE THICKNESS(in)" : INPUT T2(K),T3(K)
2540 PRINT "INPUT MORE DATA Y/N?" : INPUT A$
2550 IF LEFT$(A$,1) = "Y" OR LEFT$(A$,1) = "y" THEN GOTO 2570
2560 GOTO 2590
2570 K=K+1
2580 GOTO 2510
2590 NT=K
2600 CLS : PRINT : PRINT : PRINT
2610 LPRINT : LPRINT : LPRINT : LPRINT : LPRINT
2620 LPRINT CHR$(27);CHR$(88);CHR$(1);CHR$(27);CHR$(87);CHR$(1);
2630 LPRINT "  @@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@" : LPRINT
2640 LPRINT "          ICE THICKNESSES     " : LPRINT
2650 LPRINT "  @@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@" : LPRINT
2660 LPRINT CHR$(27);CHR$(87);CHR$(0)
2670 LPRINT
2680 LPRINT "     SITE NAME ",ICE$ : LPRINT
2690 LPRINT "     DATE ",ICE1$ : LPRINT
2700 LPRINT : LPRINT "     ALL DISTANCES ARE FROM THE GREEN SIDE BASELINE"
```

```
2710 LPRINT
2720 LPRINT "                    DIST. TO          DEPTH AT       ICE THICK "
2730 LPRINT "                 *** LOC.(ft)  ***  ***LOC.(ft)***  *** (in.) ***
 " : LPRINT
2740 FOR K=1 TO NT
2750 LPRINT
2760 LPRINT "     LOCATION";K;
2770 LPRINT USING "       ####.#    ";T1(K);
2780 LPRINT USING "       ###.#   ";T2(K);
2790 LPRINT USING "          ##.#  ";T3(K)
2800 NEXT K
2810 GOTO 160
2820 REM
2830 REM  ENTER INTIAL DATA FOR CROSS-SECTION
2840 REM
2850 REM
2860 E = 0
2870 CLS:PRINT:PRINT :PRINT
2880 PRINT "THIS ROUTINE IS DESIGNED TO ALLOW INPUT" : PRINT
2890 PRINT "AND STORAGE OF CROSS-SECTION DATA." : PRINT : PRINT
2900 PRINT "ALL DISTANCES SHOULD BE INPUT FROM A BASE" : PRINT
2910 PRINT "ON THE GREEN SIDE WHICH IS THE LEFT SIDE" : PRINT
2920 PRINT "LOOKING UP RIVER." : PRINT
2930 PRINT "INPUT DATA AS      DISTANCE,ELEVATION" : PRINT
2940 PRINT "FOR EACH DATA POINT." : PRINT : PRINT
2950 PRINT "              HIT SPACE BAR TO CONTINUE."
2960 Q$=INKEY$: IF Q$() " " THEN GOTO 2960
2970 CLS
2980 E = E + 1
2990 PRINT : PRINT : PRINT : PRINT
3000 INPUT "ENTER DISTANCE FROM REFERENCE(X) AND ELEVATION(Y),(enter (-1,0) to e
nd data entry) ",XC(E),YC(E)
3010     IF XC(E) = -1 THEN E = E - 1 : GOTO 3040
3020     PRINT
3030 GOTO 2980
3040 CLS : PRINT : PRINT
3050 PRINT "CHECK DATA TO SEE IF YOU WANT TO MAKE ANY CHANGES"
3060 PRINT : PRINT
3070 PRINT "DATA WILL BE DISPLAYED 20 LINES AT A TIME."
3080 PRINT : PRINT : PRINT
3090 PRINT "        HIT SPACE BAR TO CONTINUE."
3100 Q$=INKEY$ : IF Q$() " " THEN GOTO 3100
3110 M=1
3120 N=20
3130 CLS : PRINT
3140 PRINT "DATA POINT   DISTANCE(X)     ELEVATION(Y)"
3150 IF E<N THEN N=E
3160 FOR I = M TO N
3170     PRINT I,XC(I),YC(I)
3180 NEXT I
3190 J = 1
3200 INPUT "DO YOU WANT TO CHANGE ANY DATA POINTS (Yes/No)   ",A$
3210 J = J + 1
3220 IF LEFT$(A$,1) = "Y" OR LEFT$(A$,1) = "y" THEN GOTO 3240
```

```
3230 GOTO 3340
3240 CLS:PRINT :PRINT :PRINT
3250 INPUT "ENTER DATA POINT  ",A
3260 IF A > E THEN E = A
3270 PRINT
3280 INPUT "ENTER DISTANCE(X) AND ELEVATION(Y)  ",B,C
3290 PRINT
3300 XC(A) = B
3310 YC(A) = C
3320 IF J = 2 THEN GOTO 3110
3330 GOTO 3200
3340 IF E<=N THEN GOTO 3380
3350 M=M+20
3360 N=N+20
3370 GOTO 3130
3380 FOR I = 1 TO E
3390    XX(I) = XC(I)
3400    YY(I) = YC(I)
3410 NEXT I
3420 GOSUB 3500 :  REM    SORT DATA POINTS
3430 FOR I = 1 TO E
3440    XC(I) = XX(I)
3450    YC(I) = YY(I)
3460 NEXT I
3470 GOSUB 3740 :  REM  PUT DATA ON DISK
3480 GOTO 160
3490 REM
3500 REM   SORT DATA
3510 REM
3520 REM
3530 CLS : PRINT : PRINT : PRINT
3540 PRINT "    Wait.....(SORTING DATA)"
3550 NUMPT=E
3560 J6 = NUMPT
3570 J6 = INT(J6 / 2)
3580 IF J6 = 0 THEN 3710
3590 J2 = NUMPT - J6
3600 FOR J = 1 TO J2
3610     I = J
3620     J3 = I + J6
3630     IF XX(I) <= XX(J3) THEN 3690
3640     H1 = XX(I) : H2 = YY(I)
3650     XX(I) = XX(J3) : YY(I) = YY(J3)
3660     XX(J3) = H1 : YY(J3) = H2
3670     I = I - J6
3680     IF I>0 THEN 3620
3690 NEXT J
3700 GOTO 3570
3710 RETURN : REM FROM SHELL SORT
3720 REM
3730 REM
3740 REM   PUT DATA ON DISK
3750 REM
3760 REM
```

```
3770 CLS:PRINT:PRINT
3780 PRINT "PUT DATA DISK IN DRIVE 'B':PRINT:PRINT
3790 PRINT "HIT SPACE BAR TO CONTINUE."
3800 Q$=INKEY$:IF Q$()" " THEN GOTO 3800
3810 CLS
3820 PRINT
3830 PRINT
3840 PRINT
3850 PRINT:INPUT "INPUT NAME OF NEW DATA FILE B:",A$ : PRINT
3860 A$="B:"+A$
3870 OPEN A$ FOR OUTPUT AS 1
3880 INPUT "NAME OF SECTION  ";HEAD$
3890 PRINT #1,HEAD$ : PRINT
3900 INPUT "DATE OF SOUNDING ";HEAD1$
3910 PRINT #1,HEAD1$ : PRINT
3920 INPUT "WATER SURFACE ELEVATION = ";HEAD2$
3930 PRINT#1,HEAD2$ : PRINT
3940 PRINT#1,E
3950 FOR I=1 TO E
3960 PRINT #1,XC(I);YC(I)
3970 NEXT I
3980 CLOSE #1
3990 RETURN : REM  FROM PUTTING DATA ON DISK
4000 REM
4010 REM
4020 REM  TO CHANGE EXISTING DATA FILE
4030 REM
4040 CLS:PRINT :PRINT :PRINT
4050 PRINT "  THIS ROUTINE IS DESIGNED TO ALLOW CHANGES" : PRINT
4060 PRINT "  OF AN EXISTING CROSS-SECTION DATA FILE." : PRINT
4070 PRINT "  AFTER THE DATA HAS BEEN READ IT WILL BE" : PRINT
4080 PRINT "  DISPLAYED 20 LINES AT A TIME TO DETERMINE" : PRINT
4090 PRINT "  WHICH POINTS ARE TO BE CHANGED. THE NEW FILE " : PRINT
4100 PRINT "  WILL THEN BE STORED ON THE DATA DISK.TO ADD" : PRINT
4110 PRINT "  A POINT INPUT THE NEXT NUMBER AFTER THE LAST" : PRINT
4120 PRINT "  DATA POINT IN THE FILE AND THE COMPUTER WILL " : PRINT
4130 PRINT "  STORE IT IN ITS CORRECT PLACE IN THE FILE." : PRINT
4140 PRINT "          PUT DATA DISK IN DRIVE 'B'" ;PRINT
4150 PRINT "          HIT SPACE BAR TO CONTINUE."
4160 Q$=INKEY$:IF Q$() " " THEN GOTO 4160
4170 GOSUB 4530 :  REM TO GET DATA OFF DISK
4180 M=1 : N=20
4190 CLS:PRINT :PRINT
4200 IF E(=N THEN N=E
4210 PRINT "DATA POINT    DISTANCE(X)    ELEVATION(Y)"
4220 FOR I = M TO N
4230     PRINT I,XC(I),YC(I)
4240 NEXT I
4250 PRINT :PRINT
4260 INPUT "DO YOU WANT TO CHANGE ANY OF THESE DATA POINTS (Yes/No)   ",A$
4270 IF LEFT$(A$,1) = "Y" OR LEFT$(A$,1) = "y" THEN GOTO 4310
4280 IF E(=N THEN GOTO 4400
4290 M=M+20 : N=N+20
4300 GOTO 4190
```

```
4310 J = 1
4320 CLS:PRINT :PRINT :PRINT
4330 INPUT "ENTER POINT YOU WANT TO CHANGE OR ADD, DISTANCE(X),AND ELEVATION(Y)"
,A,B,C
4340 XC(A) = B
4350 YC(A) = C
4360 IF A ) E THEN E = A
4370 IF E=A THEN N=N+1
4380 IF J ( 3 THEN J = J + 1 ELSE GOTO 4190
4390 GOTO 4130
4400 FOR I = 1 TO E
4410    XX(I) = XC(I)
4420    YY(I) = YC(I)
4430 NEXT I
4440 GOSUB 3500 : REM   SORT THE DATA
4450 FOR I = 1 TO E
4460    XC(I) = XX(I)
4470    YC(I) = YY(I)
4480 NEXT I
4490 GOSUB 3740 : REM   PUT THE DATA ON DISK
4500 GOTO 160
4510 REM
4520 REM
4530 REM   GET DATA FROM DISK
4540 REM
4550 REM
4560 CLS:PRINT :PRINT :PRINT
4570 PRINT :INPUT "INPUT NAME OF DATA FILE B:",A$ :PRINT
4580 A$="B:"+A$
4590 OPEN A$ FOR INPUT AS 1
4600 INPUT #1,HEAD$
4610 PRINT : PRINT "NAME OF SECTION   ";HEAD$
4620 INPUT #1,HEAD1$
4630 PRINT : PRINT "DATE OF SOUNDING   ";HEAD1$
4640 INPUT #1,HEAD2$
4650 PRINT : PRINT "WATER SURFACE ELEVATION AT DATE =   ";HEAD2$
4660 INPUT#1,E
4670 PRINT : PRINT "NUMBER OF DATA POINTS =  ";E
4680 PRINT:PRINT
4690 I=1
4700 INPUT #1, XC(I),YC(I)
4710 IF I=E THEN GOTO 4740
4720 I=I+1
4730 GOTO 4700
4740 PRINT : PRINT "END OF DATA FILE   ";A$
4750 CLOSE #1
4760 PRINT:PRINT
4770 PRINT "HIT SPACE BAR TO CONTINUE."
4780 D$=INKEY$:IF D$() " " THEN GOTO 4780
4790 RETURN : REM   GET DATA FROM DISK
4800 REM
4810 REM PRINT CROSS-SECTION DATA
4820 REM
4830 CLS:PRINT:PRINT:PRINT
```

```
4840 PRINT "PUT PRINTER ON LINE - PLACE PRINTER HEAD" : PRINT
4850 PRINT "AT THE TOP OF THE PAGE." : PRINT
4860 PRINT
4870 PRINT "PUT DATA DISK IN DRIVE 'B'"
4880 PRINT:PRINT
4890 PRINT "HIT SPACE BAR TO CONTINUE."
4900 Q$=INKEY$:IF Q$() " " THEN GOTO 4900
4910 GOSUB 4530 : REM GET DATA FROM DISK
4920 LPRINT:LPRINT:LPRINT:LPRINT:LPRINT:LPRINT:LPRINT
4930 LPRINT CHR$(27);CHR$(88);CHR$(1);CHR$(27);CHR$(87);CHR$(1);
4940 LPRINT "  @@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@"
4950 LPRINT "              SOUNDING DATA   ": LPRINT
4960 LPRINT "   NAME OF SECTION     ";HEAD$
4970 LPRINT "  @@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@"
4980 LPRINT CHR$(27);CHR$(87);CHR$(0)
4990 LPRINT : LPRINT,"     DATE OF SOUNDING     ";HEAD1$
5000 LPRINT : LPRINT,"     WATER SURFACE ELEVATION in feet =  ";HEAD2$
5010 LPRINT:LPRINT
5020 M=1
5030 N=40
5040 GOTO 5120
5050 LPRINT CHR$(27);CHR$(87);CHR$(1);
5060 LPRINT "  @@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@"
5070 LPRINT "     SOUNDING DATA  (continued) ": LPRINT
5080 LPRINT "   NAME OF SECTION     ";HEAD$
5090 LPRINT "  @@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@"
5100 LPRINT CHR$(27);CHR$(87);CHR$(0)
5110 LPRINT:LPRINT
5120 LPRINT "                DATA POINT     DISTANCE(ft)     ELEVATION(ft)"
5130 IF E(N THEN N=E
5140 LPRINT
5150 FOR I=M TO N
5160 LPRINT USING  "                    ###         ";I;
5170 LPRINT USING  "####.#           ";XC(I);
5180 LPRINT USING  "#####.#       ";YC(I)
5190 NEXT I
5200 IF E(=N GOTO 5260
5210 M=N+1
5220 N=N+44
5230 LPRINT:LPRINT:LPRINT:LPRINT:LPRINT:LPRINT:LPRINT:LPRINT:LPRINT:LPRINT
5240 LPRINT
5250 GOTO 5050
5260 GOTO 160 : REM FROM PRINT X-SECT. DATA
5270 REM: ENTER INTIAL DATA FOR DRAWDOWNS
5280 REM
5290 REM
5300 E = 0
5310 CLS :PRINT :PRINT
5320 PRINT "THIS ROUTINE IS DESIGNED TO ALLOW INPUT" : PRINT
5330 PRINT "AND STORAGE OF DRAWDOWN DATA." : PRINT : PRINT
5340 PRINT "ALL DISTANCES SHOULD BE INPUT FROM A BASE" : PRINT
5350 PRINT "ON THE GREEN SIDE WHICH IS THE LEFT SIDE" : PRINT
5360 PRINT "LOOKING UP RIVER." : PRINT
5370 PRINT "INPUT DATA AS      TIME,GAUGE READING" : PRINT
```

```
5380 PRINT "FOR EACH DATA POINT." : PRINT : PRINT
5390 PRINT "              HIT SPACE BAR TO CONTINUE."
5400 Q$=INKEY$: IF Q$() " " THEN GOTO 5400
5410 CLS
5420 E = E + 1
5430 PRINT : PRINT : PRINT : PRINT
5440 INPUT "TIME FROM '0' in sec, AND GAUGE READING in inches-(enter (-1,0) to c
nd data entry) ",TC(E),DRC(E)
5450     IF TC(E) = -1 THEN E = E - 1 : GOTO 5480
5460     PRINT
5470 GOTO 5420
5480 CLS : PRINT : PRINT
5490 PRINT "CHECK DATA TO SEE IF YOU WANT TO MAKE ANY CHANGES"
5500 PRINT : PRINT
5510 PRINT "DATA WILL BE DISPLAYED 20 LINES AT A TIME."
5520 PRINT : PRINT : PRINT
5530 PRINT "        HIT SPACE BAR TO CONTINUE."
5540 Q$=INKEY$ : IF Q$() " " THEN GOTO 5540
5550 M=1
5560 N=20
5570 CLS : PRINT
5580 PRINT "DATA POINT     TIME(T)        READING(Y)"
5590 IF E(N THEN N=E
5600 FOR I = M TO N
5610     PRINT I,TC(I),DRC(I)
5620 NEXT I
5630 J = 1
5640 INPUT "DO YOU WANT TO CHANGE ANY DATA POINTS (Yes/No)   ",A$
5650 J = J + 1
5660 IF LEFT$(A$,1) = "Y" OR LEFT$(A$,1) = "y" THEN GOTO 5680
5670 GOTO 5780
5680 PRINT
5690 INPUT "ENTER DATA POINT  ",A
5700 IF A ) E THEN E = A
5710 PRINT
5720 INPUT "ENTER TIME(T) AND GAUGE READING(Y)  ",B,C
5730 PRINT
5740 TC(A) = B
5750 DRC(A) = C
5760 IF J = 2 THEN GOTO 5570
5770 GOTO 5640
5780 IF E(=N THEN GOTO 5820
5790 M=M+20
5800 N=N+20
5810 GOTO 5570
5820 FOR I = 1 TO E
5830    XX(I) = TC(I)
5840    YY(I) = DRC(I)
5850 NEXT I
5860 GOSUB 3500 :  REM    SORT DATA POINTS
5870 FOR I = 1 TO E
5880    TC(I) = XX(I)
5890    DRC(I) = YY(I)
5900 NEXT I
```

```
5910 GOSUB 5950 :  REM  PUT DATA ON DISK
5920 GOTO 160
5930 REM
5940 REM
5950 REM   PUT DRAWDOWN DATA ON DISK
5960 REM
5970 REM
5980 CLS:PRINT:PRINT
5990 PRINT "PUT DATA DISK IN DRIVE 'B'":PRINT:PRINT
6000 PRINT "HIT SPACE BAR TO CONTINUE."
6010 Q$=INKEY$:IF Q$()" " THEN GOTO 6010
6020 CLS
6030 PRINT
6040 PRINT
6050 PRINT
6060 PRINT:INPUT "INPUT NAME OF NEW DATA FILE B:",A$
6070 A$="B:"+A$
6080 OPEN A$ FOR OUTPUT AS 1
6090 INPUT "NAME OF SECTION  ";HEAD$
6100 PRINT #1,HEAD$
6110 INPUT "DATE OF OBSERVATION ";HEAD1$
6120 PRINT #1,HEAD1$
6130 INPUT "VESSEL NAME  ";HEAD3$
6140 PRINT #1,HEAD3$
6150 INPUT "UPBOUND or DOWNBOUND  ";HEAD9$
6160 PRINT #1,HEAD9$
6170 INPUT "VESSEL LENGTH (ft) = ";HEAD4$
6180 PRINT #1,HEAD4$
6190 INPUT "VESSEL BEAM (ft) = ";HEAD5$
6200 PRINT #1,HEAD5$
6210 INPUT "VESSEL DRAFT (ft) = ";HEAD6$
6220 PRINT #1,HEAD6$
6230 INPUT "VESSEL SPEED (ft/sec) = ";HEAD7$
6240 PRINT #1,HEAD7$
6250 INPUT "BOW ON TIME (sec) = ";HEADA$
6260 PRINT #1,HEADA$
6270 INPUT "STERN ON TIME (sec) = ";HEADB$
6280 PRINT #1,HEADB$
6290 INPUT "DISTANCE TO STAFF GAUGE from green side (ft) = ";HEADC$
6300 PRINT #1,HEADC$
6310 INPUT "BACKGROUND READING (in) = ";HEAD2
6320 PRINT#1,HEAD2
6330 PRINT#1,E
6340 FOR I=1 TO E
6350 PRINT #1,TC(I);DRC(I)
6360 NEXT I
6370 CLOSE #1
6380 RETURN : REM  FROM PUTTING DATA ON DISK
6390 REM
6400 REM PRINT DRAWDOWN DATA
6410 REM
6420 CLS:PRINT:PRINT:PRINT
6430 PRINT "PUT PRINTER ON LINE - PLACE PRINTER HEAD" : PRINT
6440 PRINT "AT THE TOP OF THE PAGE" : PRINT
```

```
6450 PRINT
6460 PRINT "PUT DATA DISK IN DRIVE 'B'"
6470 PRINT:PRINT
6480 PRINT "HIT SPACE BAR TO CONTINUE."
6490 Q$=INKEY$:IF Q$() " " THEN GOTO 6490
6500 GOSUB 7070 : REM GET DATA FROM DISK
6510 LPRINT:LPRINT:LPRINT:LPRINT:LPRINT:LPRINT:LPRINT
6520 LPRINT CHR$(27);CHR$(88);CHR$(1);
6530 LPRINT "       @@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@"
6540 LPRINT "           DRAWDOWN DATA   ": LPRINT
6550 LPRINT "           NAME OF SECTION     ";HEAD$
6560 LPRINT "       @@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@"
6570 LPRINT : LPRINT "          DATE OF OBSERVATION     ";HEAD1$
6580 LPRINT : LPRINT "          VESSEL NAME    ";HEAD3$
6590 LPRINT : LPRINT "          DIRECTION    ";HEAD9$
6600 LPRINT : LPRINT "          VESSEL LENGTH in feet =  ";HEAD4$
6610 LPRINT : LPRINT "          VESSEL BEAM in feet =  ";HEAD5$
6620 LPRINT : LPRINT "          VESSEL DRAFT in feet =  ";HEAD6$
6630 LPRINT : LPRINT "          VESSEL SPEED in feet/sec. =  ";HEAD7$
6640 LPRINT : LPRINT "          BOW ON TIME in sec =  ";HEAD4$
6650 LPRINT : LPRINT "          STERN ON TIME in sec =  ";HEAD8$
6660 LPRINT : LPRINT "          DISTANCE TO STAFF GAUGE from green side in feet
=  ";HEAD8$
6670 LPRINT : LPRINT "          BACKGROUND READING in inches =  ";HEAD2
6680 LPRINT:LPRINT
6690 M=1
6700 N=20
6710 NO=N
6720 GOTO 6790
6730 REM
6740 LPRINT "       @@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@"
6750 LPRINT "           DRAWDOWN DATA  (continued) ": LPRINT
6760 LPRINT "           NAME OF SECTION     ";HEAD$
6770 LPRINT "       @@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@"
6780 LPRINT:LPRINT
6790 LPRINT "                                        GAUGE         CHANGE "
6800 LPRINT "         DATA POINT   TIME(sec)   READING(in)   FROM BG(in)"
6810 IF E(N THEN N=E
6820 LPRINT
6830 FOR I=M TO N
6840 Z(I) = DRC(I) - HEAD2
6850 LPRINT USING  "            ###        ";I;
6860 LPRINT USING  "####.#      ";TC(I);
6870 LPRINT USING  "#####.#       ";DRC(I);
6880 LPRINT USING "###.#      ";Z(I)
6890 NEXT I
6900 IF E(=N GOTO 6970
6910 M=N+1
6920 N=N+44
6930 NO=N
6940 LPRINT:LPRINT:LPRINT:LPRINT:LPRINT:LPRINT:LPRINT:LPRINT:LPRINT:LPRINT
6950 LPRINT:LPRINT:LPRINT
6960 GOTO 6730
6970 M=NO-E+6
```

```
6980 FOR I=1 TO MN
6990 LPRINT
7000 NEXT I
7010 CLS : PRINT : PRINT : PRINT : PRINT
7020 INPUT "DO YOU WANT TO PRINT ANOTHER (Yes/No) ";A$
7030 IF LEFT$(A$,1) = "Y" OR LEFT$(A$,1) = "y" THEN GOTO 6510
7040 GOTO 160 : REM FROM PRINT DRAWDOWN DATA
7050 REM
7060 REM
7070 REM   GET DRAWDOWN DATA FROM DISK
7080 REM
7090 REM
7100 CLS:PRINT :PRINT :PRINT
7110 PRINT:INPUT "INPUT NAME OF NEW DATA FILE B:",A$ : PRINT
7120 A$="B:"+A$
7130 OPEN A$ FOR INPUT AS 1
7140 INPUT #1,HEAD$
7150 PRINT : PRINT "NAME OF SECTION  ";HEAD$
7160 INPUT #1,HEAD1$
7170 PRINT "DATE OF OBSERVATION ";HEAD1$
7180 INPUT #1,HEAD3$
7190 PRINT "VESSEL NAME  ";HEAD3$
7200 INPUT #1,HEAD9$
7210 PRINT "UPBOUND or DOWNBOUND  ";HEAD9$
7220 INPUT #1,HEAD4$
7230 PRINT "VESSEL LENGTH (ft) = ";HEAD4$
7240 INPUT #1,HEAD5$
7250 PRINT "VESSEL BEAM (ft) = ";HEAD5$
7260 INPUT #1,HEAD6$
7270 PRINT "VESSEL DRAFT (ft) = ";HEAD6$
7280 INPUT #1,HEAD7$
7290 PRINT "VESSEL SPEED (ft/sec) = ";HEAD7$
7300 INPUT #1,HEADA$
7310 PRINT "BOW ON TIME (sec) = ";HEADA$
7320 INPUT #1,HEADB$
7330 PRINT "STERN ON TIME (sec) = ";HEADB$
7340 INPUT #1,HEADB$
7350 PRINT "DISTANCE TO STAFF GAUGE from green side (ft) = ";HEADB$
7360 INPUT#1,HEAD2
7370 PRINT "BACKGROUND READING (in) = ";HEAD2
7380 INPUT#1,E
7390 I=1
7400 INPUT #1,TC(I),DRC(I)
7410 IF I=E THEN GOTO 7450
7420 I = I + 1
7430 GOTO 7400
7440 PRINT : PRINT "END OF DATA FILE   ";A$
7450 CLOSE #1
7460 PRINT :PRINT "              HIT SPACE BAR TO CONTINUE."
7470 Q$=INKEY$: IF Q$() " " THEN GOTO 7470
7480 RETURN : REM  FROM PUTTING DATA ON DISK
```

ONE.SUB

```
100 CLEAR
110 DIM XC(200),YC(200),XX(200),YY(200),YTEMP(200),I(200),J(200),YN(200)
120 DIM E(200),A(200),TC(200),DRC(200),Z(200)
130 DIM D$(5),P$(5),Q$(5),T1(20),TURB7(20),T2(50),T3(50)
140 DIM X(50),Y(50),YP(50),R(50),NT(20),YPR(50),XPR(50)
150 DIM XD(50),YD(50),YPD(50),RD(50)
160 CLS : KEY OFF
170 PRINT :PRINT
180 PRINT "                              OPTIONS" : PRINT
190 PRINT "          ********************************************":PRINT
200 PRINT "             0   RETURN TO MAIN PROGRAM MENU"
210 PRINT
220 PRINT "             1   CALCULATE AREAS AND TOPWIDTHS OF CROSS-SECTIONS"
230 PRINT
240 PRINT "             2   CALCULATE DRAWDOWNS USING A SINGLE VESSEL SPEED"
250 PRINT "                 AND GIVE RELATIVE DAMAGE"
260 PRINT
270 PRINT "             3   CALCULATE DRAWDOWNS ITERATING VESSEL SPEED"
280 PRINT "                 AND GIVE RELATIVE DAMAGE"
290 PRINT
300 PRINT "             4   FIT LIGHT METER DATA TO LINE AND GIVE RESULTS"
310 PRINT
320 PRINT:INPUT "                       INPUT OPTION   ";OPT
330 IF OPT = 0 THEN GOTO 400
340  IF (OPT(1) OR (OPT )4) THEN PRINT"BAD OPTION NUMBER":GOTO 170
350 CLS
360 PRINT : PRINT : PRINT : PRINT
370 ON OPT  GOSUB 710, 1860, 390, 7320
380 GOTO 160
390 LOAD"THREE.SUB",R
400 LOAD"BEGIN.TWO",R
410 CLS : GOTO 170
420 REM
430 REM
440 REM   GET DATA FROM DISK
450 REM
460 REM
470 CLS:PRINT:PRINT
480 PRINT :INPUT "INPUT NAME OF DATA FILE B:",A$ :PRINT
490 A$="B:"+A$
500 OPEN A$ FOR INPUT AS 1
510 INPUT #1,HEAD$
520 PRINT : PRINT "NAME OF SECTION   ";HEAD$
530 INPUT #1,HEAD1$
540 PRINT : PRINT "DATE OF SOUNDING   ";HEAD1$
550 INPUT #1,HEAD2$
560 PRINT : PRINT "WATER SURFACE ELEVATION AT DATE =   ";HEAD2$
570 INPUT#1,E
```

```
580 PRINT : PRINT "NUMBER OF DATA POINTS =  ";E
590 I=1
600 INPUT #1, XC(I),YC(I)
610 IF I=E THEN GOTO 640
620 I=I+1
630 GOTO 600
640 PRINT : PRINT "END OF DATA FILE   ";A$
650 CLOSE #1
660 PRINT:PRINT
670 PRINT "HIT SPACE BAR TO CONTINUE."
680 D$=INKEY$:IF D$() " " THEN GOTO 680
690 RETURN : REM   GET DATA FROM DISK
700 REM
710 REM CALCULATE AREA1, AREA2, TOPWIDTH
720 REM
730 CLS : PRINT : PRINT : PRINT
740 PRINT "THIS ROUTINE ALLOWS FOR CALCULATION OF AREAS" : PRINT
750 PRINT "AND TOPWIDTHS OF RIVER SECTIONS USING STORED " : PRINT
760 PRINT "CROSS-SECTION DATA. IT WILL CALCULATE THE TOTAL" : PRINT
770 PRINT "AREA AND TOP WIDTH PLUS THE AREAS ON THE RED AND" : PRINT
780 PRINT "GREEN SIDES OF THE VESSEL." : PRINT : PRINT
790 PRINT "PUT DATA DISK IN DRIVE 'B'." : PRINT
800 PRINT "HIT SPACE BAR TO CONTINUE."
810 D$=INKEY$:IF D$() " " THEN GOTO 810
820 GOSUB 440 : REM GET DATA FROM DISK
830 GOTO 860
840 CLS:PRINT:PRINT:PRINT
850 PRINT "CALCULATE AREAS WITH DATA INPUT."
860 CLS:PRINT:PRINT:PRINT
870 INPUT "WATER SURFACE ELEVATION = WS = ";WS
880 PRINT:PRINT
890 INPUT "ENTER DISTANCE TO UPBOUND VESSEL FROM GREEN SIDE in feet = ";DC(1)
900 PRINT:PRINT
910 INPUT "ENTER DISTANCE TO DOWNBOUND VESSEL FROM GREEN SIDE in feet = ";DC(2)
920 CLS : PRINT :PRINT:PRINT
930 PRINT "   wait......."
940     FOR I = 1 TO E
950         YTEMP(I) = WS - YC(I)
960     NEXT I
970  FOR J=1 TO 2
980  AREA1(J)=0:AREA2(J)=0:XPREV=0:YPREV=0
990      B=E+1
1000     FOR I = 1 TO E
1010         IF XC(I)=XPREV GOTO 1030
1020         GOTO 1040
1030         XC(I)=XC(I)+.1
1040         IF I ) B THEN GOTO 1240
1050         IF XC(I) ) DC(J) THEN GOTO 1140
1060         IF YTEMP(I) (= 0 THEN GOTO 1290
1070 IF YPREV ( 0 GOTO 1100
1080         AREA1(J)=AREA1(J)+((XC(I)-XPREV)*(.5)*(YTEMP(I)+YPREV))
1090 GOTO 1110
1100 AREA1(J)=AREA1(J)+((.5)*((YTEMP(I))/(YTEMP(I)-YPREV))*(YTEMP(I))*(XC(I)-XPR
EV))
```

```
1110          XPREV = XC(I)
1120          YPREV = YTEMP(I)
1130          GOTO 1310
1140          B = I
1150  AREA1(J)=AREA1(J)+((XC(I)-XPREV)*(.5)*(YTEMP(I)+YPREV)*((DC(J)-XPREV)/(XC(
I)-XPREV)))
1160 IF J=1 THEN GOTO 1190
1170  D6=YPREV + (YTEMP(I)-YPREV)*((DC(J)-XPREV)/(XC(I)-XPREV))
1180 GOTO 1200
1190  D5=YPREV + (YTEMP(I)-YPREV)*((DC(J)-XPREV)/(XC(I)-XPREV))
1200  AREA2(J)=AREA2(J)+((XC(I)-XPREV)*(.5)*(YTEMP(I)+YPREV)*((XC(I)-DC(J))/(XC(
I)-XPREV)))
1210          XPREV = XC(I)
1220          YPREV = YTEMP(I)
1230          GOTO 1310
1240          IF YPREV (= 0 GOTO 1290
1250 IF YTEMP(I)(0 GOTO 1280
1260          AREA2(J)=AREA2(J)+((XC(I)-XPREV)*(.5)*(YTEMP(I)+YPREV))
1270 GOTO 1290
1280 AREA2(J)=AREA2(J)+((.5)*((YPREV)/(YPREV-YTEMP(I)))*(YPREV)*(XC(I)-XPREV))
1290          XPREV = XC(I)
1300          YPREV = YTEMP(I)
1310     NEXT I
1320  NEXT J
1330          AREA=AREA1(1)+AREA2(1)
1340  XPREV=0
1350  YPREV=0
1360     FOR I = 1 TO E
1365          IF YTEMP(1)=0 THEN GOTO 1500
1370          IF YTEMP(I)=YPREV GOTO 1390
1380          GOTO 1400
1390          YTEMP(I)=YTEMP(I)+.1
1400          IF XC(I)=XPREV GOTO 1420
1410          GOTO 1430
1420          XC(I)=XC(I)+.1
1430          IF XC(I) ( DC(1) THEN GOTO 1450
1440          IF XC(I) )= DC(1) THEN GOTO 1540
1450          IF YTEMP(I)(0 GOTO 1510
1460          IF YPREV )= 0 GOTO 1510
1470          IF YTEMP(I)=0 GOTO 1500
1480          L1=XPREV+((XC(I)-XPREV)*((YTEMP(I))/(YTEMP(I)-YPREV)))
1490          GOTO 1510
1500          L1 = XC(I)
1510          XPREV = XC(I)
1520          YPREV = YTEMP(I)
1530          GOTO 1610
1540          IF YPREV ( 0 GOTO 1510
1550          IF YPREV = 0 GOTO 1590
1560          IF YTEMP(I))=0 GOTO 1510
1570          L2=XPREV+((XC(I)-XPREV)*((YPREV)/(YPREV-YTEMP(I))))
1580          GOTO 1510
1590          L2 = XPREV
1600          GOTO 1510
1610     NEXT I
1620          TW = ABS(L2 - L1)
```

```
1630 CLS
1640 PRINT
1650 PRINT
1660 PRINT "NAME OF SECTION          ";HEAD$ : PRINT
1670 PRINT USING "WATER SURFACE ELEVATION in feet = ####.## ";WS : PRINT
1680 PRINT "DISTANCE TO UPBOUND VESSEL from green side in feet = ";DC(1):PRINT
1690 PRINT "DEPTH AT CENTER OF UPBOUND VESSEL in feet = ";D5 : PRINT
1700 PRINT "DISTANCE TO DOWNBOUND VESSEL from green side in feet = ";DC(2):PRINT
1710 PRINT "DEPTH AT CENTER OF DOWNBOUND VESSEL in feet = ";D6 : PRINT
1720 PRINT USING "TOTAL AREA OF SECTION in sq. feet = ######. ";TAREA : PRINT
1730 PRINT "          HIT SPACE BAR TO CONTINUE."
1740 Q$=INKEY$: IF Q$() " " THEN GOTO 1740
1750 CLS : PRINT
1760 PRINT USING "AREA ON GREEN SIDE OF UPBOUND VESSEL in sq. feet = ######.";AR
EA1(1):PRINT
1770 PRINT USING "AREA ON RED SIDE OF UPBOUND VESSEL in sq. feet = ######.";AREA
2(1) : PRINT
1780 PRINT USING "AREA ON GREEN SIDE OF DOWNBOUND VESSEL in sq. feet = ######.";
AREA1(2):PRINT
1790 PRINT USING "AREA ON RED SIDE OF DOWNBOUND VESSEL in sq. feet = ######.";AR
EA2(2):PRINT
1800 PRINT USING "WIDTH OF WATER SURFACE in feet = ######.# ";TW : PRINT
1810 PRINT
1820 INPUT "DO YOU WANT A HARD COPY (Yes/No)";A$
1830 IF LEFT$(A$,1) = "Y" OR LEFT$(A$,1) = "y" THEN GOTO 7040
1840 RETURN : REM FROM PRINTING OUTPUT
1850 REM
1860 REM CALCULATE DRAWDOWNS
1870 REM
1880 CLS : PRINT : PRINT : PRINT
1890 PRINT "THIS ROUTINE ALLOWS FOR CALCULATION OF DRAWDOWNS" : PRINT
1900 PRINT "AND DAMAGE FOR THE PASSAGE OF A VESSEL UPBOUND," : PRINT
1910 PRINT "DOWNBOUND OR BOTH DIRECTIONS FOR A GIVEN SPEED." : PRINT
1920 PRINT "IT WILL ALSO GIVE A PRINTOUT OF THE RESULTS" : PRINT
1930 PRINT "IF PROMPTED BY THE USER." : PRINT : PRINT
1940 PRINT "HIT SPACE BAR TO CONTINUE."
1950 Q$=INKEY$:IF Q$() " " THEN GOTO 1950
1960 CLS : PRINT : PRINT : PRINT
1970 PRINT "CHOOSE ONE OF THE FOLLOWING OPTIONS" :PRINT
1980 PRINT "CALCULATE DRAWDOWNS FOR" : PRINT
1990 PRINT 1, "UPBOUND VESSEL ONLY" : PRINT
2000 PRINT 2, "DOWNBOUND VESSEL ONLY" : PRINT
2010 PRINT 3, "BOTH UPBOUND & DOWNBOUND VESSELS" : PRINT : PRINT
2020 INPUT "                    INPUT OPTION  ";DIRV
2030 IF (DIRV(1) OR (DIRV)3) THEN GOTO 1960
2040 CLS : PRINT : PRINT : PRINT : PRINT
2050 INPUT "NAME OF SECTION   ",Z$
2060 ON DIRV GOTO 2070, 2110, 2070
2070 PRINT
2080 INPUT "AREA ON GREEN SIDE OF UPBOUND VESSEL in sq. feet = ";AREA1
2090 PRINT
2100 INPUT "AREA ON RED SIDE OF UPBOUND VESSEL in sq. feet = ";AREA2
2110 ON DIRV GOTO 2160, 2120, 2120
2120 PRINT
```

```
2130 INPUT "AREA ON GREEN SIDE OF DOWNBOUND VESSEL in sq. feet = ";AREA3
2140 PRINT
2150 INPUT "AREA ON RED SIDE OF DOWNBOUND VESSEL in sq. feet = ";AREA4
2160 PRINT
2170 INPUT "WIDTH OF WATER SURFACE in feet = ";TW
2180 CLS : PRINT : PRINT : PRINT : PRINT
2190 PRINT "THE FOLLOWING TWO INPUT PARAMETERS ALLOW"
2200 PRINT : PRINT "EXAMINATION OF THE ICE COVERED CONDITION"
2210 PRINT : PRINT "ON THE SYSTEM. INPUT PERCENTAGE OF AREA"
2220 PRINT : PRINT "TAKEN UP BY ICE AS A DECIMEL MULTIPLIER"
2230 PRINT : PRINT "OF THE TOTAL AREA OF THE SECTION. INPUT"
2240 PRINT : PRINT "0 FOR ICE FREE CONDITIONS."
2250 PRINT : PRINT
2260 INPUT "PERCENTAGE ICE on green side (decimal form) = ";I1
2270 PRINT
2280 INPUT "PERCENTAGE ICE on red side (decimal form) = ";I2
2290 IT=((I1+I2)*(AREA1+AREA2))/TW
2300 RED=1
2310 CLS : PRINT : PRINT : PRINT
2320 ON RED GOTO 2330, 2350
2330 PRINT "INPUT THE NEARSHORE CONFIGURATION ON THE GREEN SIDE" :PRINT
2340 GOTO 2360
2350 PRINT "INPUT THE NEARSHORE CONFIGURATION ON THE RED SIDE" :PRINT
2360 PRINT "CHOOSE ONE OF THE FOLLOWING OPTIONS" : PRINT
2370 PRINT 1, "OPEN BLUFF OR ESCARPMENT" : PRINT
2380 PRINT 2, "OPEN SLOPING BEACH" : PRINT
2390 PRINT 3, "SUBMERGED WETLANDS" : PRINT
2400 PRINT 4, "MANMADE PROTECTION" : PRINT : PRINT
2410 ON RED GOTO 2420, 2450
2420 INPUT "                    INPUT OPTION  ";NCG
2430 IF (NCG<1) OR (NCG>4) THEN GOTO 2310
2440 GOTO 2470
2450 INPUT "                    INPUT OPTION  ";NCR
2460 IF (NCR<1) OR (NCR>4) THEN GOTO 2310
2470 CLS : PRINT : PRINT : PRINT
2480 ON RED GOTO 2490, 2510
2490 PRINT "INPUT THE NEARSHORE SOIL TYPE ON THE GREEN SIDE" :PRINT
2500 GOTO 2520
2510 PRINT "INPUT THE NEARSHORE SOIL TYPE ON THE RED SIDE" :PRINT
2520 PRINT "CHOOSE ONE OF THE FOLLOWING OPTIONS" : PRINT
2530 PRINT 1, "BOULDERS AND/OR COBBLES" : PRINT
2540 PRINT 2, "COARSE TO MEDIUM SAND" : PRINT
2550 PRINT 3, "MEDIUM SAND TO SILT" : PRINT
2560 PRINT 4, "CLAY" : PRINT : PRINT
2570 ON RED GOTO 2580, 2610
2580 INPUT "                    INPUT OPTION  ";SLG
2590 IF (SLG<1) OR (SLG>4) THEN GOTO 2470
2600 GOTO 2630
2610 INPUT "                    INPUT OPTION  ";SLR
2620 IF (SLR<1) OR (SLR>4) THEN GOTO 2470
2630 ON RED GOTO 2640, 2920
2640 ON SLG GOTO 2650, 2680, 2710, 2740
2650 M61=1.17 : M62=100
2660 SLGR$="BOULDERS AND/OR COBBLES"
```

```
2670 GOTO 2760
2680 MG1=.5 : MG2=1!
2690 SLGR$="COARSE TO MEDIUM SAND"
2700 GOTO 2760
2710 MG1=.42 : MG2=.83
2720 SLGR$="MEDIUM SAND TO SILT"
2730 GOTO 2760
2740 MG1=100 : MG2=100
2750 SLGR$="CLAY"
2760 ON NCG GOTO 2770, 2800, 2830, 2860
2770 MFG=1
2780 NCGR$="OPEN BLUFF OR ESCARPMENT"
2790 GOTO 2880
2800 MFG=1
2810 NCGR$="OPEN SLOPING BEACH"
2820 GOTO 2880
2830 MFG=1
2840 NCGR$="SUBMERGED WETLANDS"
2850 GOTO 2880
2860 MFG=1
2870 NCGR$="MANMADE PROTECTION"
2880 MG1=MFG*MG1
2890 MG2=MFG*MG2
2900 RED=2
2910 GOTO 2310
2920 ON SLR GOTO 2930, 2960, 2990, 3020
2930 MR1=1.17 : MR2=100
2940 SLRE$="BOULDERS AND/OR COBBLES"
2950 GOTO 3040
2960 MR1=.5 : MR2=1!
2970 SLRE$="COARSE TO MEDIUM SAND"
2980 GOTO 3040
2990 MR1=.42 : MR2=.83
3000 SLRE$="MEDIUM SAND TO SILT"
3010 GOTO 3040
3020 MR1=100 : MR2=100
3030 SLRE$="CLAY"
3040 ON NCR GOTO 3050, 3080, 3110, 3140
3050 MFR=1
3060 NCRE$="OPEN BLUFF OR ESCARPMENT"
3070 GOTO 3160
3080 MFR=1
3090 NCRE$="OPEN SLOPING BEACH"
3100 GOTO 3160
3110 MFR=1
3120 NCRE$="SUBMERGED WETLANDS"
3130 GOTO 3160
3140 MFR=1
3150 NCRE$="MANMADE PROTECTION"
3160 MR1=MFR*MR1
3170 MR2=MFR*MR2
3180 CLS : PRINT : PRINT : PRINT
3190 ON DIRV GOTO 3200, 3210, 3200
3200 INPUT "DISTANCE TO UPBOUND VESSEL from green side in feet = ";P
```

```
3210 ON DIRV GOTO 3240, 3220, 3220
3220 PRINT
3230 INPUT "DISTANCE TO DOWNBOUND VESSEL from green side in feet = ";P1
3240 PRINT
3250 INPUT "VESSEL BEAM in feet = ";B
3260 PRINT
3270 INPUT "VESSEL DRAFT in feet = ";D
3280 PRINT
3290 INPUT "RIVER VELOCITY in feet per sec. = ";V1
3300 ON DIRV GOTO 3310, 3330, 3310
3310 PRINT
3320 INPUT "UPBOUND VESSEL VELOCITY in feet per sec. = ";V2U
3330 ON DIRV GOTO 3360, 3340, 3340
3340 PRINT
3350 INPUT "DOWNBOUND VESSEL VELOCITY in feet per sec. = ";V2D
3360 PRINT
3370 INPUT "DEPTH AT CENTER OF CHANNEL in feet = ";D1
3380 G=32.2
3390 ARE1=AREA1
3400 ARE2=AREA2
3410 ARE3=AREA3
3420 ARE4=AREA4
3430 ON DIRV GOTO 3440, 3720, 3440
3440 CLS : PRINT : PRINT : PRINT : PRINT
3450 PRINT "    Wait.....(STEADY STATE - UPBOUND)"
3460 Y1=0!
3470 TW1=P
3480 CRITU=1
3490 PLACE=1
3500 RUNU=1
3510 AREA1=AREA1-(I1*AREA1)
3520 AREA2=AREA2-(I2*AREA2)
3530 YC1=(AREA1-((B*D)*(.5))-((((((V2U+V1)*AREA1)^2)*TW1)/G)^(1/3)))/TW1
3540 TW2=TW-P
3550 YC2=(AREA2-((B*D)*(.5))-((((((V2U+V1)*AREA2)^2)*TW2)/G)^(1/3)))/TW2
3560 A21=AREA1-(Y1*TW1)-((B*D)*(.5))
3570 IF (((V2U+V1)^2)*(AREA1^2)*(TW1-(B/2)))/(G*(A21^3)) >= 1 THEN GOTO 4180
3580 Y2U1=((((V1+V2U)*AREA1)^2)/(((A21)^2)*2*G))-(((V1+V2U)^2)/(2*G))
3590 IF (Y2U1+D)>D1 GOTO 4010
3600 IF (Y2U1-Y1)<.01 GOTO 3630
3610 Y1=Y1+.01
3620 GOTO 3560
3630 Y1 = 0!
3640 RUNU=2
3650 A22=AREA2-(Y1*TW2)-((B*D)*(.5))
3660 IF (((V2U+V1)^2)*(AREA2^2)*(TW2-(B/2)))/(G*(A22^3)) >= 1 THEN GOTO 4180
3670 Y2U2=((((V1+V2U)*AREA2)^2)/(((A22)^2)*2*G))-(((V1+V2U)^2)/(2*G))
3680 IF (Y2U2+D)>D1 GOTO 4010
3690 IF (Y2U2-Y1)<.01 GOTO 3720
3700 Y1=Y1+.01
3710 GOTO 3650
3720 Y1=0!
3730 ON DIRV GOTO 4540, 3740, 3740
3740 PLACE=2
```

```
3750 CRITD=1
3760 RUND=1
3770 CLS : PRINT : PRINT : PRINT : PRINT
3780 PRINT "    Wait.....(STEADY STATE - DOWNBOUND)"
3790 TW3=P1
3800 AREA3=AREA3-(I1*AREA3)
3810 AREA4=AREA4-(I2*AREA4)
3820 YC3=(AREA3-((B*D)*(.5))-((((((V2D-V1)*AREA3)^2)*TW3)/G)^(1/3)))/TW3
3830 TW4=TW-P1
3840 YC4=(AREA4-((B*D)*(.5))-((((((V2D-V1)*AREA4)^2)*TW4)/G)^(1/3)))/TW4
3850 A11=AREA3-(Y1*TW3)-((B*D)*(.5))
3860 IF (((V2D-V1)^2)*(AREA3^2)*(TW3-(B/2)))/(G*(A11^3)) )= 1 THEN GOTO 4180
3870 Y2D1=((((V2D-V1)*AREA3)^2)/(((A11)^2)*2*G))-(((V2D-V1)^2)/(2*G))
3880 IF (Y2D1+D))D1 GOTO 4010
3890 IF (Y2D1-Y1)(.01 GOTO 3920
3900 Y1=Y1+.01
3910 GOTO 3850
3920 Y1=0'
3930 RUND=2
3940 A12=AREA4-(Y1*TW4)-((B*D)*(.5))
3950 IF (((V2D-V1)^2)*(AREA4^2)*(TW4-(B/2)))/(G*(A12^3)) )= 1 THEN GOTO 4180
3960 Y2D2=((((V2D-V1)*AREA4)^2)/(((A12)^2)*2*G))-(((V2D-V1)^2)/(2*G))
3970 IF (Y2D2+D))D1 GOTO 4010
3980 IF (Y2D2-Y1)(.01 GOTO 4540
3990 Y1=Y1+.01
4000 GOTO 3940
4010 CLS:PRINT:PRINT
4020 ON PLACE GOTO 4030, 4050
4030 PRINT "THE PARAMETERS INPUT FOR THE UPBOUND VESSEL "
4040 GOTO 4070
4050 CLS:PRINT:PRINT
4060 PRINT "THE PARAMETERS INPUT FOR THE DOWNBOUND VESSEL "
4070 PRINT:PRINT "CREATE A DRAWDOWN LARGE ENOUGH"
4080 PRINT:PRINT "TO GROUND THE VESSEL. THE DRAWDOWN"
4090 PRINT:PRINT "ADDED TO THE DRAFT IS GREATER THAN"
4100 PRINT:PRINT "THE DEPTH IN THE CENTER OF THE CHANNEL.":PRINT:PRINT
4110 ON PLACE GOTO 4120, 4150
4120 INPUT "DO YOU WANT TO CHANGE ANY PARAMETERS (Yes/No) ";A$
4130 IF LEFT$(A$,1) = "Y" OR LEFT$(A$,1) = "y" THEN GOTO 5970
4140 GOTO 3720
4150 INPUT "DO YOU WANT TO CHANGE ANY PARAMETERS (Yes/No) ";A$
4160 IF LEFT$(A$,1) = "Y" OR LEFT$(A$,1) = "y" THEN GOTO 5970
4170 GOTO 4540
4180 CLS:PRINT:PRINT
4190 ON PLACE GOTO 4200, 4250
4200 PRINT "THE PARAMETERS INPUT FOR THE UPBOUND VESSEL"
4210 PRINT : PRINT "HAVE FORCED THE FLOW TO GO CRITICAL"
4220 F1=YC1
4230 F2=YC2
4240 ON RUNU GOTO 4310, 4330
4250 CLS:PRINT:PRINT
4260 F1=YC3
4270 F2=YC4
4280 PRINT "THE PARAMETERS INPUT FOR THE DOWNBOUND VESSEL"
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4290 PRINT : PRINT "HAVE FORCED THE FLOW TO GO CRITICAL"
4300 ON RUND  GOTO 4310, 4330
4310 PRINT : PRINT "ON THE GREEN SIDE."
4320 GOTO 4340
4330 PRINT : PRINT "ON THE RED SIDE."
4340 PRINT:PRINT "THE STEADY STATE MODEL DOES NOT APPLY"
4350 PRINT : PRINT "BEYOND THIS POINT."
4360 PRINT : PRINT "THE PROBABILITY FOR DAMAGE IS SEVERE."
4370 PRINT : PRINT
4380 ON PLACE GOTO 4390, 4450
4390 CRITU=2
4400 ON RUNU GOTO 4410, 4430
4410 PRINT USING "CRITICAL DRAWDOWN on the green side (ft) = #.## ";F1 : PRINT :
 PRINT
4420 GOTO 4500
4430 PRINT USING "CRITICAL DRAWDOWN on the red side (ft) = #.## ";F2 : PRINT : P
RINT
4440 GOTO 4500
4450 CRITD=2
4460 ON RUND GOTO 4470, 4490
4470 PRINT USING "CRITICAL DRAWDOWN on the green side (ft) = #.## ";F1 : PRINT :
 PRINT
4480 GOTO 4500
4490 PRINT USING "CRITICAL DRAWDOWN on the red side (ft) = #.## ";F2 : PRINT : P
RINT
4500 PRINT
4510 INPUT "DO YOU WANT TO CHANGE ANY PARAMETERS (Yes/No) ";A$
4520 IF LEFT$(A$,1) = "Y" OR LEFT$(A$,1) = "y" THEN GOTO 5960
4530 IF PLACE=1 THEN GOTO 3720 ELSE GOTO 4540
4540 CLS : PRINT : PRINT : PRINT
4550 ON DIRV GOTO 4560, 4850, 4560
4560 IF (Y2U1+D))D1 GOTO 4590
4570 IF (Y2U2+D))D1 GOTO 4590
4580 GOTO 4610
4590 PRINT "UPBOUND VESSEL IS GROUNDED." : PRINT
4600 GOTO 4630
4610 PRINT USING "   DRAWDOWN OF UPBOUND VESSEL on the green side (ft) =  #.## "
;Y2U1
4620 PRINT USING "   DRAWDOWN OF UPBOUND VESSEL on the red side (ft) =  #.## ";Y
2U2 : PRINT
4630 PRINT USING "   CRITICAL DRAWDOWN on the green side (ft) =  #.## ";YC1
4640 PRINT USING "   CRITICAL DRAWDOWN on the red side (ft) =  #.## ";YC2
4650 IF Y2U1(MG1 GOTO 4690
4660 IF Y2U1(MG2 GOTO 4710
4670 DAMGU$="SEVERE"
4680 GOTO 4720
4690 DAMGU$="NONE TO LIGHT"
4700 GOTO 4720
4710 DAMGU$="MODERATE"
4720 IF Y2U2(MR1 GOTO 4760
4730 IF Y2U2(MR2 GOTO 4780
4740 DAMRU$="SEVERE"
4750 GOTO 4790
4760 DAMRU$="NONE TO LIGHT"
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```
4770 GOTO 4790
4780 DAMRU$="MODERATE"
4790 PRINT :PRINT "   DAMAGE PROBABILITY GREEN IS ";DAMGU$
4800 PRINT :PRINT "   DAMAGE PROBABILITY RED IS ";DAMRU$
4810 ON DIRV GOTO 5130, 4820, 4820
4820 PRINT : PRINT
4830 PRINT "   HIT SPACE BAR FOR DOWNBOUND RESULTS"
4840 Q$=INKEY$:IF Q$()" " THEN GOTO 4840
4850 CLS : PRINT : PRINT : PRINT
4860 ON DIRV GOTO 5140, 4870, 4870
4870 IF (Y2D1+D))D1 GOTO 4900
4880 IF (Y2D2+D))D1 GOTO 4900
4890 GOTO 4920
4900 PRINT "DOWNBOUND VESSEL IS GROUNDED." : PRINT
4910 GOTO 4940
4920 PRINT USING "   DRAWDOWN OF DOWNBOUND VESSEL on the green side (ft) =  #.##
 ";Y2D1
4930 PRINT USING "   DRAWDOWN OF DOWNBOUND VESSEL on the red side (ft) =  #.## "
;Y2D2 : PRINT
4940 PRINT USING "   CRITICAL DRAWDOWN on the green side (ft) =  #.## ";YC3
4950 PRINT USING "   CRITICAL DRAWDOWN on the red side (ft) =  #.## ";YC4
4960 IF Y2D1(MG1 GOTO 5000
4970 IF Y2D1(MG2 GOTO 5020
4980 DAMGD$="SEVERE"
4990 GOTO 5030
5000 DAMGD$="NONE TO LIGHT"
5010 GOTO 5030
5020 DAMGD$="MODERATE"
5030 IF Y2D2(MR1 GOTO 5070
5040 IF Y2D2(MR2 GOTO 5090
5050 DAMRD$="SEVERE"
5060 GOTO 5100
5070 DAMRD$="NONE TO LIGHT"
5080 GOTO 5100
5090 DAMRD$="MODERATE"
5100 PRINT :PRINT "   DAMAGE PROBABILITY GREEN IS ";DAMGD$
5110 PRINT :PRINT "   DAMAGE PROBABILITY RED IS ";DAMRD$
5120 PRINT
5130 PRINT "   ************************************************"
5140 PRINT:PRINT
5150 INPUT "DO YOU WANT A HARD COPY (Yes/No)";A$
5160 IF LEFT$(A$,1) = "Y" OR LEFT$(A$,1) = "y" THEN GOTO 5180
5170 GOTO 5190
5180 GOSUB 5230
5190 PRINT:PRINT
5200 INPUT "DO YOU WANT TO TRY OTHER DATA (Yes/No)";A$
5210 IF LEFT$(A$,1) = "Y" OR LEFT$(A$,1) = "y" THEN GOTO 5960
5220 RETURN  :  REM FROM CALCULATING DRAWDOWNS
5230 REM
5240 REM SEND OUTPUT TO PRINTER
5250 REM
5260 CLS : PRINT : PRINT : PRINT
5270 PRINT "PUT PRINTER ON LINE" : PRINT : PRINT
5280 PRINT "HIT SPACE BAR TO CONTINUE."
```

```
5290 Q$=INKEY$:IF Q$<> " " THEN GOTO 5290
5300 LPRINT:LPRINT:LPRINT:LPRINT:LPRINT
5310 LPRINT "  @@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@"
5320 LPRINT
5330 LPRINT "  NAME OF SECTION   ",Z$
5340 LPRINT
5350 LPRINT "  @@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@" : LPRINT
5360 ON DIRV GOTO 5370, 5390, 5370
5370 LPRINT "  AREA ON GREEN SIDE OF UPBOUND VESSEL (sq. ft) =  ",ARE1
5380 LPRINT "  AREA ON RED SIDE OF UPBOUND VESSEL (sq. ft) =  ",ARE2
5390 ON DIRV GOTO 5420, 5400, 5400
5400 LPRINT "  AREA ON GREEN SIDE OF DOWNBOUND VESSEL (sq. ft) = ",ARE3
5410 LPRINT "  AREA ON RED SIDE OF DOWNBOUND VESSEL (sq. ft) = ",ARE4
5420 LPRINT "  NEARSHORE GREEN - ",NCGR$
5430 LPRINT "  SOIL TYPE GREEN - ",SLGR$
5440 LPRINT "  NEARSHORE RED - ",NCRE$
5450 LPRINT "  SOIL TYPE RED - ",SLRE$
5460 LPRINT "  PERCENTAGE ICE on green side (decimal form) = ",I1
5470 LPRINT "  PERCENTAGE ICE on red side (decimal form) = ",I2
5480 LPRINT "  WIDTH OF WATER SURFACE (ft) =  ",TW
5490 ON DIRV GOTO 5500, 5510, 5500
5500 LPRINT "  DISTANCE TO UPBOUND VESSEL from green side (ft) =",P
5510 ON DIRV GOTO 5530, 5520, 5520
5520 LPRINT "  DISTANCE TO DOWNBOUND VESSEL from green side (ft) =",P1
5530 LPRINT "  VESSEL BEAM (ft) =  ",B
5540 LPRINT "  VESSEL DRAFT (ft) =  ",D
5550 LPRINT "  RIVER VELOCITY (ft per sec.) =  ",V1
5560 ON DIRV GOTO 5570, 5580, 5570
5570 LPRINT "  UPBOUND VESSEL VELOCITY (ft per sec.) =  ",V2U
5580 ON DIRV GOTO 5600, 5590, 5590
5590 LPRINT "  DOWNBOUND VESSEL VELOCITY (ft per sec.) =  ",V2D
5600 LPRINT "  DEPTH AT CENTER OF CHANNEL (ft) =  ",D1 : LPRINT
5610 LPRINT
5620 LPRINT "****************************************************************" : L
PRINT
5630 ON DIRV GOTO 5640, 5780, 5640
5640 IF (Y2U1+D)>D1 GOTO 5670
5650 IF (Y2U2+D)>D1 GOTO 5670
5660 IF CRITU=2 GOTO 5710 ELSE GOTO 5690
5670 LPRINT "UPBOUND VESSEL IS GROUNDED." : LPRINT
5680 GOTO 5710
5690 LPRINT USING "DRAWDOWN OF UPBOUND VESSEL on the green side (ft) =  #.## ";Y
2U1
5700 LPRINT USING "DRAWDOWN OF UPBOUND VESSEL on the red side (ft) =  #.## ";Y2U
2 : LPRINT
5710 LPRINT USING "CRITICAL DRAWDOWN on the green side (ft) =  #.## ";YC1
5720 LPRINT USING "CRITICAL DRAWDOWN on the red side (ft) =  #.## ";YC2
5730 LPRINT :LPRINT "PROBABLE DAMAGE GREEN SIDE = ";DAMGU$
5740 LPRINT "PROBABLE DAMAGE RED SIDE = ";DAMRU$
5750 ON DIRV GOTO 5900, 5760, 5760
5760 LPRINT
5770 LPRINT "****************************************************************" : L
PRINT
5780 IF (Y2D1+D)>D1 GOTO 5810
```

```
5790 IF (Y2D2+D))D1 GOTO 5810
5800 IF CRITD=2 GOTO 5860 ELSE GOTO 5840
5810 LPRINT "DOWNBOUND VESSEL IS GROUNDED." : LPRINT
5820 GOTO 5860
5830 GOTO 5700
5840 LPRINT USING "DRAWDOWN OF DOWNBOUND VESSEL on the green side (ft) =  #.## "
;Y2D1
5850 LPRINT USING "DRAWDOWN OF DOWNBOUND VESSEL on the red side (ft) =  #.## ";Y
2D2 : LPRINT
5860 LPRINT USING "CRITICAL DRAWDOWN on the green side (ft) =  #.## ";YC3
5870 LPRINT USING "CRITICAL DRAWDOWN on the red side (ft) =  #.## ";YC4
5880 LPRINT :LPRINT "PROBABLE DAMAGE GREEN SIDE = ";DAMGD$
5890  LPRINT "PROBABLE DAMAGE RED SIDE = ";DAMRD$
5900 LPRINT
5910 LPRINT "************************************************************"
5920 CLS:PRINT :PRINT:PRINT
5930 INPUT "DO YOU WANT A ANOTHER COPY (Yes/No)";A$
5940 IF LEFT$(A$,1) = "Y" OR LEFT$(A$,1) = "y" THEN GOTO 5230
5950 RETURN  :  REM FROM PRINTING OUTPUT
5960 REM
5970 REM TO CHANGE DATA
5980 REM
5990 AREA1=ARE1
6000 AREA2=ARE2
6010 AREA3=ARE3
6020 AREA4=ARE4
6030 CLS:PRINT:PRINT:PRINT
6040 PRINT "THE FOLLOWING MENU ALLOWS FOR CHANGES IN THE DATA JUST RUN"
6050 PRINT:PRINT
6060 PRINT "INPUT OPTION # OF PARAMETER YOU WANT TO CHANGE."
6070 PRINT:PRINT
6080 PRINT "THE OPTIONS ARE BROKEN INTO 2 LISTS"
6090 PRINT:PRINT
6100 PRINT "OPTION '0' WILL RECALCULATE THE DRAWDOWNS WITH THE NUMBERS CHANGED"
6110 PRINT:PRINT
6120 PRINT "HIT SPACE BAR TO CONTINUE."
6130 Q$=INKEY$:IF Q$()" " THEN GOTO 6130
6140 CLS
6150 PRINT
6160 PRINT 0, "RECALCULATE DRAWDOWNS WITH DATA CHANGED"
6170 PRINT
6180 PRINT 1, "AREA ON GREEN SIDE OF UPBOUND VESSEL"
6190 PRINT
6200 PRINT 2, "AREA ON RED SIDE OF UPBOUND VESSEL"
6210 PRINT
6220 PRINT 3, "AREA ON GREEN SIDE OF DOWNBOUND VESSEL"
6230 PRINT
6240 PRINT 4, "AREA ON RED SIDE OF DOWNBOUND VESSEL"
6250 PRINT
6260 PRINT 5, "PERCENTAGE ICE ON GREEN SIDE"
6270 PRINT
6280 PRINT 6, "PERCENTAGE ICE ON RED SIDE"
6290 PRINT
6300 PRINT 7, "DISTANCE TO UPBOUND VESSEL"
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6310 PRINT
6320 PRINT 8, "DISTANCE TO DOWNBOUND VESSEL"
6330 PRINT
6340 PRINT 9, "SECOND LIST OF INPUT DATA"
6350 PRINT:INPUT "                                        OPTION #    ";OPT
6360 IF OPT = 0 THEN GOTO 6420
6370 IF OPT=9 THEN GOTO 6430
6380 IF (OPT(1) OR (OPT)9) THEN PRINT "BAD OPTION # " : GOTO 6030
6390 CLS:PRINT:PRINT:PRINT:PRINT:PRINT
6400 ON OPT GOSUB 6690,6720,6750,6780,6810,6830,6870,6890,6430
6410 GOTO 6140
6420 GOTO 3380
6430 CLS :PRINT
6440 PRINT 0, "RECALCULATE DRAWDOWNS WITH DATA CHANGED"
6450 PRINT
6460 PRINT 1, "WIDTH OF WATER SURFACE"
6470 PRINT
6480 PRINT 2, "VESSEL BEAM"
6490 PRINT
6500 PRINT 3, "VESSEL DRAFT"
6510 PRINT
6520 PRINT 4, "RIVER VELOCITY"
6530 PRINT
6540 PRINT 5, "UPBOUND VESSEL VELOCITY"
6550 PRINT
6560 PRINT 6, "DOWNBOUND VESSEL VELOCITY"
6570 PRINT
6580 PRINT 7, "DEPTH AT CENTER OF CHANNEL"
6590 PRINT
6600 PRINT 8, "FIRST LIST OF INPUT DATA"
6610 PRINT:INPUT "                                        OPTION #    ";OPT
6620 IF OPT=0 THEN GOTO 6420
6630 IF OPT=8 THEN GOTO 6140
6640 IF(OPT(1) OR (OPT)8) THEN PRINT "BAD OPTION #":GOTO 5330
6650 CLS
6660 PRINT:PRINT:PRINT:PRINT:PRINT
6670 ON OPT GOSUB 6850,6910,6930,6950,6970,6990,7010,6140
6680 GOTO 6140
6690 PRINT:INPUT "AREA ON GREEN SIDE OF UPBOUND VESSEL in sq. ft. = ";AREA1
6700 ARE1=AREA1
6710 RETURN
6720 PRINT:INPUT "AREA ON RED SIDE OF UPBOUND VESSEL in sq. ft. = ";AREA2
6730 ARE2=AREA2
6740 RETURN
6750 PRINT:INPUT "AREA ON GREEN SIDE OF DOWNBOUND VESSEL in sq. ft. = ";AREA3
6760 ARE3=AREA3
6770 RETURN
6780 PRINT:INPUT "AREA ON RED SIDE OF DOWNBOUND VESSEL in sq. ft. = ";AREA4
6790 ARE4=AREA4
6800 RETURN
6810 PRINT:INPUT "PERCENTAGE ICE on the green side (decimal form) = ";I1
6820 RETURN
6830 PRINT:INPUT "PERCENTAGE ICE on the red side (decimal form) = ";I2
6840 RETURN
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6850 PRINT:INPUT "WIDTH OF WATER SURFACE in feet = ";TW
6860 RETURN
6870 PRINT:INPUT "DISTANCE TO UPBOUND VESSEL from green side in feet = ";P
6880 RETURN
6890 PRINT:INPUT "DISTANCE TO DOWNBOUND VESSEL from green side in feet = ";P1
6900 RETURN
6910 PRINT:INPUT "VESSEL BEAM in feet = ";B
6920 RETURN
6930 PRINT:INPUT "VESSEL DRAFT in feet = ";D
6940 RETURN
6950 PRINT:INPUT "RIVER VELOCITY in feet per sec. = ";V1
6960 RETURN
6970 PRINT:INPUT "UPBOUND VESSEL VELOCITY in feet per sec. = ";V2U
6980 RETURN
6990 PRINT:INPUT "DOWNBOUND VESSEL VELOCITY in feet per sec. = ";V2D
7000 RETURN
7010 PRINT:INPUT "DEPTH AT CENTER OF CHANNEL in feet = ";D1
7020 RETURN
7030 REM
7040 REM PRINT AREA CALCULATION OUTPUT
7050 REM
7060 CLS : PRINT : PRINT : PRINT
7070 PRINT "PUT PRINTER ON LINE" : PRINT : PRINT
7080 PRINT "HIT SPACE BAR TO CONTINUE."
7090 Q$=INKEY$:IF Q$<> " " THEN GOTO 7090
7100 LPRINT:LPRINT:LPRINT:LPRINT:LPRINT:LPRINT:LPRINT:LPRINT:LPRINT:LPRINT
7110 LPRINT "  @@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@"
7120 LPRINT "     NAME OF SECTION      ";HEAD$ : LPRINT
7130 LPRINT
7140 LPRINT USING "     WATER SURFACE ELEVATION in feet = ####.## ";WS
7150 LPRINT "  @@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@": LPRINT
7160 LPRINT "     DISTANCE TO UPBOUND VESSEL from green side in feet = ";DC(1) : LPRINT
7170 LPRINT "     DEPTH AT CENTER OF UPBOUND VESSEL in feet = ";D5 : LPRINT
7180 LPRINT "     DISTANCE TO DOWNBOUND VESSEL from green side in feet = ";DC(2) : LPRINT
7190 LPRINT "     DEPTH AT CENTER OF DOWNBOUND VESSEL in feet = ";D6 : LPRINT
7200 LPRINT USING "     TOTAL AREA OF SECTION in sq. feet = ######.";TAREA : LPRINT
7210 LPRINT USING "     AREA ON GREEN SIDE OF UPBOUND VESSEL in sq. feet = ######. ";AREA1(1) : LPRINT
7220 LPRINT USING "     AREA ON RED SIDE OF UPBOUND VESSEL in sq. feet = ######. ";AREA2(1) : LPRINT
7230 LPRINT USING "     AREA ON GREEN SIDE OF DOWNBOUND VESSEL in sq. feet = ######. ";AREA1(2) : LPRINT
7240 LPRINT USING "     AREA ON RED SIDE OF DOWNBOUND VESSEL in sq. feet = ######. ";AREA2(2) : LPRINT
7250 LPRINT USING "     WIDTH OF WATER SURFACE in feet = ######.# ";TW : LPRINT : LPRINT
7260 CLS:PRINT:PRINT:PRINT
7270 INPUT "DO YOU WANT A ANOTHER COPY (Yes/No)";A$
7280 IF LEFT$(A$,1) = "Y" OR LEFT$(A$,1) = "y" THEN GOTO 7040
7290 GOTO 1840
7300 CLS : PRINT : PRINT : PRINT
```

```
7310 REM
7320 REM PERFORM LINEAR REGRESSION
7330 REM
7340 CLS : PRINT : PRINT : PRINT
7350 PRINT "THIS ROUTINE ALLOWS FOR CALCULATION OF THE" : PRINT
7360 PRINT "COEFFICIENT OF EXTINCTION OF LIGHT WITH " : PRINT
7370 PRINT "DEPTH FOR STORED LIGHT METER DATA. IT WILL" : PRINT
7380 PRINT "ALSO PLOT THE RESULTS ON THE SCREEN OR ON" : PRINT
7390 PRINT "THE PLOTTER IF PROMPTED." : PRINT : PRINT
7400 PRINT "PUT DATA DISK IN DRIVE 'B'."
7410 PRINT:PRINT
7420 PRINT "HIT SPACE BAR TO CONTINUE."
7430 Q$=INKEY$:IF Q$() " " THEN GOTO 7430
7440 CLS : PRINT : PRINT : PRINT
7450 INPUT "    FILE NAME?  B:",B$
7460 B$ = "B:" + B$
7470 OPEN B$ FOR INPUT AS 1
7480 INPUT #1, HEAD$
7490 PRINT : PRINT HEAD$
7500 INPUT #1, HEAD2$
7510 PRINT "DISTANCE = ",HEAD2$
7520 INPUT #1, OHR
7530 PRINT "OVERHEAD READING = ",OHR
7540 INPUT #1, ITH
7550 PRINT "ICE THICKNESS = ",ITH ;"in."
7560 INPUT #1, RUS
7570 PRINT "READING UNDER SURFACE = ",RUS
7580 I=0
7590 INPUT #1,X(I),Y(I)
7600 PRINT I+1;". ";X(I);"  ";Y(I)
7610 IF EOF(1) GOTO 7640
7620 I=I+1
7630 GOTO 7590
7640 PRINT : PRINT " END OF DATA FILE  ";B$ : PRINT
7650 INPUT "ARE DATA CORRECT (Y/N)";A$
7660 ND=I : CLOSE #1
7670 IF LEFT$(A$,1) = "N" OR LEFT$(A$,1) = "n" THEN GOTO 7300
7680 REM
7690 REM MAIN PROGRAM
7700 REM
7710 CLS : PRINT : PRINT : PRINT : PRINT
7720 PRINT "    Wait.....
7730 SX=0 : SY=0 : SXX=0 : SXY=0 : SYY=0 : SDD=0
7740 I=0
7750 IF Y(I)=0 GOTO 7790
7760 IF I=ND GOTO 7800
7770 I=I+1
7780 GOTO 7750
7790 ND=I-1
7800 N=ND
7810 FOR I=1 TO ND
7820 IF Y(I)=0 GOTO 7840
7830 GOTO 7850
7840 Y(I)=.05
```

```
7850 Y(I)=(LOG(Y(I)/RLS))*(-1)
7860 SX=SX+X(I)
7870 SY=SY+Y(I)
7880 SXX=SXX+X(I)*X(I)
7890 SXY=SXY+X(I)*Y(I)
7900 SYY=SYY+Y(I)*Y(I)
7910 NEXT I
7920 DETER=N*SXX-SX*SX
7930 IF DETER=0 THEN PRINT "DETER = 0 -- PROGRAM STOPPED" : GOTO 7950
7940 GOTO 7980
7950 INPUT "DO YOU WANT TO TRY OTHER DATA (Y/N) ";A$
7960 IF LEFT$(A$,1) = "Y" OR LEFT$(A$,1) = "y" THEN GOTO 7340
7970 GOTO 9080
7980 A1=(SXX*SY-SXY*SX)/DETER
7990 A2=(N*SXY-SX*SY)/DETER
8000 FOR I=1 TO ND
8010 YP(I)=A1+A2*X(I)
8020 R(I)=Y(I)-YP(I)
8030 SDD=SDD+R(I)*R(I)
8040 NEXT I
8050 V=SDD/(N-2)
8060 VA11=V*SXX/DETER
8070 VA22=V*N/DETER
8080 VA12=-V*SX/DETER
8090 SA1=SQR(VA11)
8100 SA2=SQR(VA22)
8110 SSX=SXX-SX*SX/N
8120 SSY=SYY-SY*SY/N
8130 SSXY=SXY-SX*SY/N
8140 COV=SSXY/N
8150 COR=SSXY/((SSX*SSY)^.5)
8160 STDEV=(ABS(SYY-A2*SY-A1*SXY)/(N-2))^.5
8170 CLS:PRINT :PRINT :PRINT
8180 GOTO 8240
8190 PRINT : PRINT "*** X ****  *** ln R/Rmax ***  **** YP ****  **** YP-Y ****"
8200 PRINT
8210 FOR I=1 TO ND
8220 PRINT TAB(4);X(I);TAB(16);Y(I);TAB(33);YP(I);TAB(49);R(I)
8230 NEXT I
8240 PRINT : PRINT USING "          Ke = #.###";A2;
8250 PRINT USING " +/- #.###";SA2
8260 PRINT :PRINT :PRINT "          NUMBER OF DATA = ";N
8270 PRINT :PRINT :PRINT
8280 PRINT :PRINT :PRINT "          END OF DATA ANALYSIS. HIT ANY KEY CONTINUE"
8290 IF INKEY$ = "" THEN GOTO 8290
8300 PLO=1
8310 XMAX=X(1)
8320 YMAX=Y(1)
8330 FOR I=1 TO ND
8340 IF X(I) ) XMAX THEN XMAX=X(I)
8350 IF Y(I) ) YMAX THEN YMAX=Y(I)
8360 IF YP(I) ) YMAX THEN YMAX=YP(I)
8370 NEXT I
8380 CLS:PRINT:PRINT:PRINT
```

```
8390 INPUT "DO YOU WANT RESULTS PLOTTED ON THE SCREEN (Y/N) ";A$
8400 IF LEFT$(A$,1) = "Y" OR LEFT$(A$,1) = "y" THEN GOTO 8430
8410 GOTO 9050
8420 REM
8430 REM PLOT DATA
8440 REM
8450 CLS
8460 KEY OFF
8470 SCREEN 1
8480 COLOR 0,3
8490 PLO=2
8500 PSET(44,4),1
8510 FOR Z=1 TO 10
8520 DRAW "L3 R3 D16"
8530 NEXT Z
8540 DRAW "L3 R3 D3 U3"
8550 FOR Z=1 TO 10
8560 DRAW "R22 D3 U3"
8570 NEXT Z
8580 FOR Z=1 TO 10
8590 DRAW "R3 L3 U16"
8600 NEXT Z
8610 DRAW "R3 L3 U3 D3"
8620 FOR Z=1 TO 10
8630 DRAW "L22 U3 D3"
8640 NEXT Z
8650 LOCATE 1,3 : PRINT "1.0"
8660 LOCATE 5,3 : PRINT "0.8"
8670 LOCATE 9,3 : PRINT "0.6"
8680 LOCATE 13,3 : PRINT "0.4"
8690 LOCATE 17,3 : PRINT "0.2"
8700 LOCATE 21,3 : PRINT "0.0"
8710 LOCATE 7,1 : PRINT "R"
8720 LOCATE 8,1 : PRINT "D"
8730 LOCATE 9,1 : PRINT "G"
8740 LOCATE 10,1 : PRINT "/"
8750 LOCATE 11,1 : PRINT "R"
8760 LOCATE 12,1 : PRINT "D"
8770 LOCATE 13,1 : PRINT "G"
8780 LOCATE 14,1 : PRINT "m"
8790 LOCATE 15,1 : PRINT "a"
8800 LOCATE 16,1 : PRINT "x"
8810 LOCATE 22,5 : PRINT "0.0          0.5          1.0"
8820 LOCATE 23,9 : PRINT "DEPTH/DEPTHmax"
8830 FOR I=1 TO ND
8840 XD(I)=X(I)/XMAX
8850 XPR(I)=XD(I)
8860 YD(I)=Y(I)/YMAX
8870 YPR(I)=YD(I)
8880 YPD(I)=YP(I)/YMAX
8890 YD(I)=164-YD(I)*160
8900 YPD(I)=164-YPD(I)*160
8910 XD(I)=44+XD(I)*220
8920 PSET (XD(I),YD(I))
```

```
8930 DRAW "BM+2,+2UAL4D4R4"
8940 NEXT I
8950 FOR I=1 TO ND-1
8960 LINE (XD(I),YPD(I))-(XD(I+1),YPD(I+1))
8970 NEXT I
8980 LOCATE 1,8 : PRINT HEAD$
8990 LOCATE 2,8 : PRINT "OVERHEAD = ";OHR
9000 LOCATE 3,8 : PRINT "UNDER SURF = ";RUS
9010 LOCATE 19,17 : PRINT USING "Ke = #.###";A2
9020 LOCATE 20,17 : PRINT "ICE THICK = ";ITH;"in."
9030 IF INKEY$ = "" THEN GOTO 9030
9040 SCREEN 0 : WIDTH 80
9050 CLS:PRINT : PRINT : PRINT
9060 INPUT "DO YOU WANT RESULTS PLOTTED ON THE HP PLOTTER (Y/N) ";A$
9070 IF LEFT$(A$,1) = "Y" OR LEFT$(A$,1) = "y" THEN GOTO 9100
9080 RETURN
9090 REM
9100 REM SEND RESULTS TO PRINTER
9110 REM
9120 CLS : PRINT : PRINT : PRINT
9130 PRINT "PUT PLOTTER ON LINE" : PRINT : PRINT
9140 PRINT "HIT SPACE BAR TO CONTINUE."
9150 Q$=INKEY$:IF Q$() " " THEN GOTO 9150
9160 OPEN "COM1:9600,S,7,1,RS,CS65535,DS,CD" AS #1
9170 PRINT #1, "IN;SP1;PA1500,6500;PD"
9180 FOR I=1 TO 10
9190 PRINT #1, "IN;YT;PD;PR0,-500;PU"
9200 NEXT I
9210 PRINT #1, "IN;YT"
9220 FOR I=1 TO 10
9230 PRINT #1, "IN;XT;PD;PR700,0;PU"
9240 NEXT I
9250 PRINT #1, "IN;XT"
9260 PRINT #1, "IN;CP-1,-1;LB1.0" + CHR$(3)
9270 PRINT #1, "CP"
9280 PRINT #1, "IN;PA7100,1500"
9290 PRINT #1, "IN;CP-1,-1;LB0.8" + CHR$(3)
9300 PRINT #1, "CP"
9310 PRINT #1, "IN;PA5700,1500"
9320 PRINT #1, "IN;CP-1,-1;LB0.6" + CHR$(3)
9330 PRINT #1, "CP"
9340 PRINT #1, "IN;PA4300,1500"
9350 PRINT #1, "IN;CP-1,-1;LB0.4" + CHR$(3)
9360 PRINT #1, "CP"
9370 PRINT #1, "IN;PA2900,1500"
9380 PRINT #1, "IN;CP-1,-1;LB0.2" + CHR$(3)
9390 PRINT #1, "CP"
9400 PRINT #1, "IN;PA1500,1500"
9410 PRINT #1, "IN;CP-1,-1;LB0.0" + CHR$(3)
9420 PRINT #1, "CP"
9430 PRINT #1, "IN;PA1500,1500"
9440 PRINT #1, "IN;CP-4,-0.1;LB0.0" + CHR$(3)
9450 PRINT #1, "CP"
9460 PRINT #1, "IN;PA1500,2500"
```

```
9470 PRINT #1, "IN;CP-4,-0.1;LB0.2" + CHR$(3)
9480 PRINT #1, "CP"
9490 PRINT #1, "IN;PA1500,3500"
9500 PRINT #1, "IN;CP-4,-0.1;LB0.4" + CHR$(3)
9510 PRINT #1, "CP"
9520 PRINT #1, "IN;PA1500,4500"
9530 PRINT #1, "IN;CP-4,-0.1;LB0.6" + CHR$(3)
9540 PRINT #1, "CP"
9550 PRINT #1, "IN;PA1500,5500"
9560 PRINT #1, "IN;CP-4,-0.1;LB0.8" + CHR$(3)
9570 PRINT #1, "CP"
9580 PRINT #1, "IN;PA1500,6500"
9590 PRINT #1, "IN;CP-4,-0.1;LB1.0" + CHR$(3)
9600 PRINT #1, "CP"
9610 PRINT #1, "IN;PA3000,7000;"
9620 PRINT #1, "SI.4,.8,LB**LIGHT METER RESULTS**" + CHR$(3)
9630 PRINT #1, "IN;PA1750,6700"
9640 PRINT #1, "LBSITE NAME "HEAD$ ""+ CHR$(3)
9650 PRINT #1, "IN;PA1750,6350"
9660 PRINT #1, "LBDIST. GREEN SIDE "HEAD2$ ""+ CHR$(3)
9670 PRINT #1, "IN;PA1750,6200"
9680 PRINT #1, "LBOVERHEAD RDG ="OHR ""+ CHR$(3)
9690 IF ITH = 0 GOTO 9730
9700 PRINT #1, "IN;PA1750,6050"
9710 PRINT #1, "LBRDG UNDER ICE SURF. ="RUS ""+ CHR$(3)
9720 GOTO 9750
9730 PRINT #1, "IN;PA1750,6050"
9740 PRINT #1, "LBRDG UNDER SURF. ="RUS ""+ CHR$(3)
9750 PRINT #1, "IN;PA7000,1950"
9760 A2=A2*100
9770 A2=INT(A2)
9780 A2=A2/100
9790 PRINT #1, "LBKe = "A2 "" + CHR$(3)
9800 IF ITH = 0 GOTO 9830
9810 PRINT #1, "IN;PA7000,1750"
9820 PRINT #1, "LBICE THICK = "ITH "in."+ CHR$(3)
9830 PRINT #1, "IN;PA4475,1000"
9840 PRINT #1, "LBDEPTH/DEPTHmax" + CHR$(3)
9850 PRINT #1, "IN;PA900,3250"
9860 PRINT #1, "DI0,1;LBREADING/READINGmax" + CHR$(3)
9870 IF PLO=1 THEN GOTO 9880 ELSE GOTO 9940
9880 FOR I=1 TO ND
9890 XD(I)=X(I)/XMAX
9900 XPR(I)=XD(I)
9910 YD(I)=Y(I)/YMAX
9920 YPR(I)=YD(I)
9930 NEXT I
9940 FOR I=1 TO ND
9950 IF PLO=3 THEN GOTO 9980
9960 XPR(I)=(XPR(I)*7000)+1500
9970 YPR(I)=(YPR(I)*5000)+1500
9980 PRINT #1, "IN;SM*;PA",XPR(I),",",YPR(I)," + CHR$(3)
9990 NEXT I
10000 I=1
```

```
10010 LPX1=((X(I)/XMAX)*7000)+1500 : LPY1=((YP(I)/YMAX)*5000)+1500
10020 I=NO
10030 LPX2=((X(I)/XMAX)*7000)+1500 : LPY2=((YP(I)/YMAX)*5000)+1500
10040 PRINT #1, "IN;PA",LPX1,",",LPY1," + CHR$(3)
10050 PRINT #1, "IN;PD;PA",LPX2,",",LPY2,";PU" + CHR$(3)
10060 PRINT #1, "PU;SP0;PA1,4000"
10070 PLO=3
10080 CLS:PRINT : PRINT : PRINT
10090 INPUT "DO YOU WANT ANOTHER PLOT (Y/N) ";A$
10100 IF LEFT$(A$,1) = "Y" OR LEFT$(A$,1) = "y" THEN GOTO 9170
10110 CLOSE #1
10120 GOTO 9080
```

THREE.SUB

```
100 CLEAR
110 KEY OFF
120 DIM YU1(200),YU2(200),YD1(200),YD2(200),VU(200),I(200),J(200),VD(200)
130 DIM E(200),A(200),Z(200),YSC1(200),YSC2(200),YSC3(200),YSC4(200)
140 DIM VUSC(200),VDSC(200)
150 REM
160 REM CALCULATE
170 REM
180 CLS : PRINT : PRINT : PRINT : PRINT
190 PRINT "THIS ROUTINE IS DESIGNED TO ITERATE UPBOUND" : PRINT
200 PRINT "AND DOWNBOUND VESSEL VELOCITIES AND CALCULATE" : PRINT
210 PRINT "THE CORRESPONDING DRAWDOWN. CALCULATIONS WILL" : PRINT
220 PRINT "BE TERMINATED WHEN CRITICAL CONDITIONS ARE" : PRINT
230 PRINT "REACHED ON ONE SIDE OF THE VESSEL OR THE OTHER." : PRINT
240 PRINT "BEGIN VELOCITY IS THE POINT THAT THE USER WANTS" : PRINT
250 PRINT "ITERATION TO START." : PRINT : PRINT
260 PRINT "HIT SPACE BAR TO CONTINUE."
270 Q$=INKEY$:IF Q$() " " THEN GOTO 270
280 CLS : PRINT : PRINT : PRINT
290 PRINT "CHOOSE ONE OF THE FOLLOWING OPTIONS" :PRINT
300 PRINT "CALCULATE DRAWDOWNS FOR" : PRINT
310 PRINT 1, "UPBOUND VESSEL ONLY" : PRINT
320 PRINT 2, "DOWNBOUND VESSEL ONLY" : PRINT
330 PRINT 3, "BOTH UPBOUND & DOWNBOUND VESSELS" : PRINT : PRINT
340 INPUT "                    INPUT OPTION  ";DIRV
350 IF (DIRV(1) OR (DIRV)3) THEN GOTO 280
360 ON DIRV GOTO 370, 370, 370
370 CLS : PRINT : PRINT : PRINT : PRINT
380 INPUT "NAME OF SECTION   ",Z$
390 ON DIRV GOTO 400, 450, 400
400 PRINT
410 INPUT "AREA ON GREEN SIDE OF UPBOUND VESSEL in sq. feet = ";AREA1
420 PRINT
430 INPUT "AREA ON RED SIDE OF UPBOUND VESSEL in sq. feet = ";AREA2
440 ON DIRV GOTO 490, 450, 450
450 PRINT
460 INPUT "AREA ON GREEN SIDE OF DOWNBOUND VESSEL in sq. feet = ";AREA3
470 PRINT
480 INPUT "AREA ON RED SIDE OF DOWNBOUND VESSEL in sq. feet = ";AREA4
490 PRINT
500 INPUT "WIDTH OF WATER SURFACE in feet = ";TW
510 CLS : PRINT : PRINT : PRINT : PRINT
520 PRINT "THE FOLLOWING TWO INPUT PARAMETERS ALLOW"
530 PRINT : PRINT "EXAMINATION OF THE ICE COVERED CONDITION"
540 PRINT : PRINT "ON THE SYSTEM. INPUT PERCENTAGE OF AREA"
550 PRINT : PRINT "TAKEN UP BY ICE AS A DECIMAL MULTIPLIER"
560 PRINT : PRINT "OF THE TOTAL AREA OF THE SECTION. INPUT"
570 PRINT : PRINT "0 FOR ICE FREE CONDITIONS."
```

```
580 PRINT : PRINT
590 INPUT "PERCENTAGE ICE on green side (decimal form) = ";I1
610 INPUT "PERCENTAGE ICE on red side (decimal form) = ";I2
620 PRINT
630 IT=((I1+I2)*(AREA1+AREA2))/TW
640 RED=1
650 CLS : PRINT : PRINT : PRINT
660 ON RED GOTO 670, 690
670 PRINT "INPUT THE NEARSHORE CONFIGURATION ON THE GREEN SIDE" :PRINT
680 GOTO 700
690 PRINT "INPUT THE NEARSHORE CONFIGURATION ON THE RED SIDE" :PRINT
700 PRINT "CHOOSE ONE OF THE FOLLOWING OPTIONS" : PRINT
710 PRINT 1, "OPEN BLUFF OR ESCARPMENT" : PRINT
720 PRINT 2, "OPEN SLOPING BEACH" : PRINT
730 PRINT 3, "SUBMERGED WETLANDS" : PRINT
740 PRINT 4, "MANMADE PROTECTION" : PRINT : PRINT
750 ON RED GOTO 760, 790
760 INPUT "                    INPUT OPTION  ";NCG
770 IF (NCG(1) OR (NCG)4) THEN GOTO 650
780 GOTO 810
790 INPUT "                    INPUT OPTION  ";NCR
800 IF (NCR(1) OR (NCR)4) THEN GOTO 650
810 CLS : PRINT : PRINT : PRINT
820 ON RED GOTO 830, 850
830 PRINT "INPUT THE NEARSHORE SOIL TYPE ON THE GREEN SIDE" :PRINT
840 GOTO 860
850 PRINT "INPUT THE NEARSHORE SOIL TYPE ON THE RED SIDE" :PRINT
860 PRINT "CHOOSE ONE OF THE FOLLOWING OPTIONS" : PRINT
870 PRINT 1, "BOULDERS AND/OR COBBLES" : PRINT
880 PRINT 2, "COARSE TO MEDIUM SAND" : PRINT
890 PRINT 3, "MEDIUM SAND TO SILT" : PRINT
900 PRINT 4, "CLAY" : PRINT : PRINT
910 ON RED GOTO 920, 950
920 INPUT "                    INPUT OPTION  ";SLG
930 IF (SLG(1) OR (SLG)4) THEN GOTO 810
940 GOTO 970
950 INPUT "                    INPUT OPTION  ";SLR
960 IF (SLR(1) OR (SLR)4) THEN GOTO 810
970 ON RED GOTO 980, 1260
980 ON SLG GOTO 990, 1020, 1050, 1080
990 MG1=1.17 : MG2=100
1000 SLGR$="BOULDERS AND/OR COBBLES"
1010 GOTO 1100
1020 MG1=.5 : MG2=1!
1030 SLGR$="COARSE TO MEDIUM SAND"
1040 GOTO 1100
1050 MG1=.42 : MG2=.83
1060 SLGR$="MEDIUM SAND TO SILT"
1070 GOTO 1100
1080 MG1=100 : MG2=100
1090 SLGR$="CLAY"
1100 ON NCG GOTO 1110, 1140, 1170, 1200
1110 MFG=1
1120 NCGR$="OPEN BLUFF OR ESCARPMENT"
```

```
1130 GOTO 1220
1140 MFG=1
1150 NCGR$="OPEN SLOPING BEACH"
1160 GOTO 1220
1170 MFG=1
1180 NCGR$="SUBMERGED WETLANDS"
1190 GOTO 1220
1200 MFG=1
1210 NCGR$="MANMADE PROTECTION"
1220 MG1=MFG*MG1
1230 MG2=MFG*MG2
1240 RED=2
1250 GOTO 650
1260 ON SLR GOTO 1270, 1300, 1330, 1360
1270 MR1=1.17 : MR2=100
1280 SLRE$="BOULDERS AND/OR COBBLES"
1290 GOTO 1380
1300 MR1=.5 : MR2=1!
1310 SLRE$="COARSE TO MEDIUM SAND"
1320 GOTO 1380
1330 MR1=.42 : MR2=.83
1340 SLRE$="MEDIUM SAND TO SILT"
1350 GOTO 1380
1360 MR1=100 : MR2=100
1370 SLRE$="CLAY"
1380 ON NCR GOTO 1390, 1420, 1450, 1480
1390 MFR=1
1400 NCRE$="OPEN BLUFF OR ESCARPMENT"
1410 GOTO 1500
1420 MFR=1
1430 NCRE$="OPEN SLOPING BEACH"
1440 GOTO 1500
1450 MFR=1
1460 NCRE$="SUBMERGED WETLANDS"
1470 GOTO 1500
1480 MFR=1
1490 NCRE$="MANMADE PROTECTION"
1500 MR1=MFR*MR1
1510 MR2=MFR*MR2
1520 CLS : PRINT : PRINT : PRINT
1530 ON DIRV GOTO 1540, 1570, 1540
1540 INPUT "DISTANCE TO UPBOUND VESSEL from green side in feet = ";P
1550 ON DIRV GOTO 1580, 1560, 1560
1560 PRINT
1570 INPUT "DISTANCE TO DOWNBOUND VESSEL from green side in feet = ";P1
1580 PRINT
1590 INPUT "VESSEL BEAM in feet = ";B
1600 PRINT
1610 INPUT "VESSEL DRAFT in feet = ";D
1620 PRINT
1630 INPUT "RIVER VELOCITY in feet per sec. = ";V1
1640 ON DIRV GOTO 1650, 1680, 1650
1650 PRINT
1660 INPUT "BEGIN UPBOUND VELOCITY in feet per sec. = ";V2UP
```

```
1670 ON DIRV GOTO 1700, 1680, 1680
1680 PRINT
1690 INPUT "BEGIN DOWNBOUND VELOCITY in feet per sec. = ";V2DP
1700 PRINT
1710 INPUT "DEPTH AT CENTER OF CHANNEL in feet = ";D1
1720 G=32.2
1730 VCHU=1
1740 VCHD=1
1750 ERASE YU1,YU2,YD1,YD2,VU,I,J,VD
1760 ERASE E,A,Z,YSC1,YSC2,YSC3,YSC4
1770 ERASE VUSC,VDSC
1780 DIM YU1(200),YU2(200),YD1(200),YD2(200),VU(200),I(200),J(200),VD(200)
1790 DIM E(200),A(200),Z(200),YSC1(200),YSC2(200),YSC3(200),YSC4(200)
1800 DIM VUSC(200),VDSC(200)
1810 ON DIRV GOTO 1820, 2420, 1820
1820 CLS : PRINT : PRINT : PRINT : PRINT
1830 PRINT "    Wait.....(STEADY STATE - UPBOUND)"
1840 AREA1=AREA1
1850 AREA2=AREA2
1860 V2U=V2UP
1870 FU1=0
1880 FU2=0
1890 TW1=P
1900 T=1
1910 VPRU=V2U
1920 VU(T)=V2U
1930 PLACE=1
1940 RUNU=1
1950 AREA1=AREA1-(I1*AREA1)
1960 AREA2=AREA2-(I2*AREA2)
1970 YC1=(AREA1-((B*D)*(.5))-((((((V2U+V1)*AREA1)^2)*TW1)/G)^(1/3)))/TW1
1980 Y1=FU1
1990 FCU=Y1
2000 TW2=TW-P
2010 YC2=(AREA2-((B*D)*(.5))-((((((V2U+V1)*AREA2)^2)*TW2)/G)^(1/3)))/TW2
2020 A21=AREA1-(Y1*TW1)-((B*D)*(.5))
2030 IF (((V2U+V1)^2)*(AREA1^2)*(TW1-(B/2)))/(G*(A21^3)) )= 1 THEN GOTO 2300
2040 Y2U1=((((V1+V2U)*AREA1)^2)/(((A21)^2)*2*G))-(((V1+V2U)^2)/(2*G))
2050 IF (Y2U1+D))D1 GOTO 3030
2060 IF (Y2U1-Y1)(.01 GOTO 2090
2070 Y1=Y1+.01
2080 GOTO 2020
2090 FU1=Y1
2100 Y1=FU2
2110 FCU2=Y1
2120 A22=AREA2-(Y1*TW2)-((B*D)*(.5))
2130 IF (((V2U+V1)^2)*(AREA2^2)*(TW2-(B/2)))/(G*(A22^3)) )= 1 THEN GOTO 2340
2140 Y2U2=((((V1+V2U)*AREA2)^2)/(((A22)^2)*2*G))-(((V1+V2U)^2)/(2*G))
2150 IF (Y2U2+D))D1 GOTO 3030
2160 IF (Y2U2-Y1)(.01 GOTO 2190
2170 Y1=Y1+.01
2180 GOTO 2120
2190 YU1(T)=Y2U1
2200 YU2(T)=Y2U2
```

```
2210 T=T+1
2220 IF VCHU = 2 GOTO 2230 ELSE GOTO 2250
2230 V2U=V2U+.05
2240 GOTO 2260
2250 V2U=V2U+.5
2260 VU(T)=V2U
2270 NU=T
2280 FU2=Y1
2290 GOTO 1970
2300 CRITU=1
2310 IF VCHU=2 GOTO 2420
2320 FU1=FCU
2330 GOTO 2370
2340 CRITU=2
2350 IF VCHU=2 GOTO 2420
2360 FU1=FCU
2370 Y1=FCU2
2380 T=T-1
2390 V2U=VU(T)
2400 VCHU=2
2410 GOTO 2210
2420 FD1=0
2430 FD2=0
2440 ARE3=AREA3
2450 ARE4=AREA4
2460 V2D=V2DP
2470 ON DIRV GOTO 3220, 2480, 2480
2480 PLACE=2
2490 RUND=1
2500 CLS : PRINT : PRINT : PRINT : PRINT
2510 PRINT "    Wait.....(STEADY STATE - DOWNBOUND)"
2520 T=1
2530 VPRD=V2D
2540 VD(T)=V2D
2550 TW3=P1
2560 AREA3=AREA3-(I1*AREA3)
2570 AREA4=AREA4-(I2*AREA4)
2580 YC3=(AREA3-((B*D)*(.5))-((((((V2D-V1)*AREA3)^2)*TW3)/G)^(1/3)))/TW3
2590 Y1=FD1
2600 FCD=Y1
2610 TW4=TW-P1
2620 YC4=(AREA4-((B*D)*(.5))-((((((V2D-V1)*AREA4)^2)*TW4)/G)^(1/3)))/TW4
2630 A11=AREA3-(Y1*TW3)-((B*D)*(.5))
2640 IF (((V2D-V1)^2)*(AREA3^2)*(TW3-(B/2)))/(G*(A11^3)) >= 1 THEN GOTO 2910
2650 Y2D1=((((V2D-V1)*AREA3)^2)/(((A11)^2)*2*G))-(((V2D-V1)^2)/(2*G))
2660 IF (Y2D1+D))D1 GOTO 3030
2670 IF (Y2D1-Y1)(.01 GOTO 2700
2680 Y1=Y1+.01
2690 GOTO 2630
2700 FD1=Y1
2710 Y1=FD2
2720 FCD2=Y1
2730 A12=AREA4-(Y1*TW4)-((B*D)*(.5))
2740 IF (((V2D-V1)^2)*(AREA4^2)*(TW4-(B/2)))/(G*(A12^3)) >= 1 THEN GOTO 2950
```

```
2750 Y2D2=((((V2D-V1)*AREA4)^2)/(((A12)^2)*2*G))-(((V2D-V1)^2)/(2*G))
2760 IF (Y2D2+D))D1 GOTO 3030
2770 IF (Y2D2-Y1)(.01 GOTO 2800
2780 Y1=Y1+.01
2790 GOTO 2730
2800 YD1(T)=Y2D1
2810 YD2(T)=Y2D2
2820 T=T+1
2830 IF VCHD=2 THEN GOTO 2840 ELSE GOTO 2860
2840 V2D=V2D+.05
2850 GOTO 2870
2860 V2D=V2D+.5
2870 VD(T)=V2D
2880 ND=T
2890 FD2=Y1
2900 GOTO 2580
2910 CRITD=1
2920 IF VCHD=2 GOTO 3220
2930 FD1=FCD
2940 GOTO 2980
2950 CRITD=2
2960 IF VCHD=2 GOTO 3220
2970 FD1=FCD
2980 Y1=FCD2
2990 T=T-1
3000 V2D=VD(T)
3010 VCHD=2
3020 GOTO 2820
3030 CLS:PRINT:PRINT
3040 ON PLACE GOTO 3050, 3080
3050 PRINT "THE PARAMETERS INPUT FOR THE UPBOUND VESSEL "
3060 RUNU=2
3070 GOTO 3110
3080 CLS:PRINT:PRINT
3090 RUND=2
3100 PRINT "THE PARAMETERS INPUT FOR THE DOWNBOUND VESSEL "
3110 PRINT:PRINT "CREATE A DRAWDOWN LARGE ENOUGH"
3120 PRINT:PRINT "TO GROUND THE VESSEL. THE DRAWDOWN"
3130 PRINT:PRINT "ADDED TO THE DRAFT IS GREATER THAN"
3140 PRINT:PRINT "THE DEPTH IN THE CENTER OF THE CHANNEL.":PRINT:PRINT
3150 ON PLACE GOTO 3160, 3190
3160 INPUT "DO YOU WANT TO CHANGE ANY PARAMETERS (Yes/No) ";A$
3170 IF LEFT$(A$,1) = "Y" OR LEFT$(A$,1) = "y" THEN GOTO 8010
3180 GOTO 2420
3190 INPUT "DO YOU WANT TO CHANGE ANY PARAMETERS (Yes/No) ";A$
3200 IF LEFT$(A$,1) = "Y" OR LEFT$(A$,1) = "y" THEN GOTO 8010
3210 GOTO 3220
3220 CLS : PRINT : PRINT : PRINT : PRINT
3230 PRINT "        wait....."
3240 GOSUB 4290
3250 CLS : PRINT : PRINT : PRINT : PRINT
3260 ON DIRV GOTO 3270, 3750, 3270
3270 ON RUNU GOTO 3280,3370
3280 PRINT "THE CALCULATION REACHED CRITICAL CONDITIONS " : PRINT
```

```
3290 T=NU
3300 ON CRITU GOTO 3310, 3340
3310 PRINT USING "ON THE GREEN SIDE OF THE UPBOUND VESSEL AT ##.## ";VU(T);
3320 PRINT "ft/sec" : PRINT : PRINT
3330 GOTO 3390
3340 PRINT USING "ON THE RED SIDE OF THE UPBOUND VESSEL AT ##.## ";VU(T);
3350 PRINT "ft/sec" : PRINT : PRINT
3360 GOTO 3390
3370 PRINT USING "THE UPBOUND VESSEL IS GROUNDED AT ##.## ";VU(T);
3380 PRINT "ft/sec" : PRINT : PRINT
3390 PRINT "DAMAGE PROBABILITY GREEN SIDE IS";PRINT
3400 IF V2UG=0 THEN GOTO 3440
3410 PRINT USING "    NONE TO LIGHT FROM 0 ft/sec to ##.## ";V1UG;
3420 PRINT "ft/sec":PRINT
3430 GOTO 3460
3440 PRINT "    NONE TO LIGHT from 0 ft/sec to CRITICAL": PRINT :PRINT
3450 GOTO 3550
3460 IF V3UG=0 THEN GOTO 3530
3470 PRINT USING "    MODERATE from ##.## ";V1UG;
3480 PRINT USING "ft/sec to ##.## ";V2UG;
3490 PRINT "ft/sec":PRINT
3500 PRINT USING "    SEVERE above ##.## ";V2UG;
3510 PRINT "ft/sec":PRINT
3520 GOTO 3550
3530 PRINT USING "    MODERATE above ##.## ";V2UG;
3540 PRINT "ft/sec":PRINT
3550 PRINT "DAMAGE PROBABILITY RED SIDE IS":PRINT
3560 IF V2UR=0 THEN GOTO 3600
3570 PRINT USING "    NONE TO LIGHT FROM 0 ft/sec to ##.## ";V1UR;
3580 PRINT "ft/sec":PRINT
3590 GOTO 3620
3600 PRINT "    NONE TO LIGHT from 0 ft/sec to CRITICAL": PRINT :PRINT
3610 GOTO 3710
3620 IF V3UR=0 THEN GOTO 3690
3630 PRINT USING "    MODERATE from ##.## ";V1UR;
3640 PRINT USING "ft/sec to ##.## ";V2UR;
3650 PRINT "ft/sec";PRINT
3660 PRINT USING "    SEVERE above ##.## ";V2UR;
3670 PRINT "ft/sec":PRINT
3680 GOTO 3710
3690 PRINT USING "    MODERATE above ##.## ";V2UR;
3700 PRINT "ft/sec":PRINT
3710 PRINT "HIT SPACE BAR TO CONTINUE."
3720 Q$=INKEY$:IF Q$()" " THEN GOTO 3720
3730 CLS:PRINT :PRINT :PRINT :PRINT
3740 ON DIRV GOTO 4210, 3750, 3750
3750 ON RND GOTO 3760,3850
3760 PRINT "THE CALCULATION REACHED CRITICAL CONDITIONS " : PRINT
3770 T=ND
3780 ON CRITD GOTO 3790, 3820
3790 PRINT USING "ON THE GREEN SIDE OF THE DOWNBOUND VESSEL AT ##.## ";VD(T);
3800 PRINT "ft/sec" : PRINT : PRINT
3810 GOTO 3870
3820 PRINT USING "ON THE RED SIDE OF THE DOWNBOUND VESSEL AT ##.## ";VD(T);
```

```
3830 PRINT "ft/sec" : PRINT : PRINT
3840 GOTO 3870
3850 PRINT "THE DOWNBOUND VESSEL IS GROUNDED AT ##.## ";VU(T);
3860 PRINT "ft/sec": PRINT : PRINT
3870 PRINT "DAMAGE PROBABILITY GREEN SIDE IS":PRINT
3880 IF V2DG=0 THEN GOTO 3920
3890 PRINT USING "    NONE TO LIGHT FROM 0 ft/sec to ##.## ";V1DG;
3900 PRINT "ft/sec":PRINT
3910 GOTO 3940
3920 PRINT "    NONE TO LIGHT from 0 ft/sec to CRITICAL": PRINT :PRINT
3930 GOTO 4030
3940 IF V3DG=0 THEN GOTO 4010
3950 PRINT USING "    MODERATE from ##.## ";V1DG;
3960 PRINT USING "ft/sec to ##.## ";V2DG;
3970 PRINT "ft/sec":PRINT
3980 PRINT USING "    SEVERE above ##.## ";V2DG;
3990 PRINT "ft/sec":PRINT
4000 GOTO 4030
4010 PRINT USING "    MODERATE above ##.## ";V2DG;
4020 PRINT "ft/sec":PRINT
4030 PRINT "DAMAGE PROBABILITY RED SIDE IS":PRINT
4040 IF V2DR=0 THEN GOTO 4080
4050 PRINT USING "    NONE TO LIGHT FROM 0 ft/sec to ##.## ";V1DR;
4060 PRINT "ft/sec":PRINT
4070 GOTO 4100
4080 PRINT "    NONE TO LIGHT from 0 ft/sec to CRITICAL": PRINT :PRINT
4090 GOTO 4190
4100 IF V3DR=0 THEN GOTO 4170
4110 PRINT USING "    MODERATE from ##.## ";V1DR;
4120 PRINT USING "ft/sec to ##.## ";V2DR;
4130 PRINT "ft/sec":PRINT
4140 PRINT USING "    SEVERE above ##.## ";V2DR;
4150 PRINT "ft/sec":PRINT
4160 GOTO 4190
4170 PRINT USING "    MODERATE above ##.## ";V2DR;
4180 PRINT "ft/sec":PRINT
4190 PRINT "HIT SPACE BAR TO CONTINUE."
4200 Q$=INKEY$:IF Q$()" " THEN GOTO 4200
4210 CLS : PRINT : PRINT : PRINT : PRINT
4220 PRINT "THE FOLLOWING IS A LIST OF THE RESULTS FOR " : PRINT
4230 PRINT "THE VELOCITY VS DRAWDOWN CALCULATIONS. THE" : PRINT
4240 PRINT "RESULTS WILL BE GIVEN 15 LINES AT A TIME " : PRINT
4250 PRINT : PRINT
4260 PRINT "HIT SPACE BAR TO CONTINUE."
4270 Q$=INKEY$:IF Q$()" " THEN GOTO 4270
4280 GOTO 5120
4290 ON DIRV GOTO 4300, 4700, 4300
4300 T=1 : HS=1
4310 IF YU1(T)(MG1 GOTO 4400
4320 IF YU1(T)(MG2 GOTO 4380
4330 V2UG=VU(T-1)+((YU1(T)-MG2)/(YU1(T)-YU1(T-1))*(VU(T)-VU(T-1)))
4340 T=NU-1
4350 V3UG=VU(T)
4360 PUG=YU1(T)
```

```
437[illegible] GOTO 4440
438[illegible] IF HS=2 GOTO 4410
439[illegible] HS=1
4400 V1DG=VD(T-1)+((YD1(T)-MG1)/(YD1(T)-YD1(T-1))*(VD(T)-VD(T-1)))
4410 T=T+1
4420 IF T=ND GOTO 4440
4430 GOTO 4310
4440 IF YD1(ND-1)(MG1 THEN GOTO 4470
4450 IF YD1(ND-1)(MG2 THEN GOTO 4490
4460 GOTO 4500
4470 V2DG=0 : V3DG=0
4480 V1DG=VD(ND-1)
4490 GOTO 4500
4495 V2DG=VD(ND-1) : V3DG=0
4500 T=1 : HS=1
4510 IF YD2(T)(MR1 GOTO 4600
4520 IF YD2(T)(MR2 GOTO 4580
4530 V2UR=VU(T-1)+((YU2(T)-MR2)/(YU2(T)-YU2(T-1))*(VU(T)-VU(T-1)))
4540 T=NU-1
4550 V3UR=VU(T)
4560 P1R=YU2(T)
4570 GOTO 4700
4580 IF HS=2 GOTO 4610
4590 HS=2
4600 V1UR=VU(T-1)+((YU2(T)-MR1)/(YU2(T)-YU2(T-1))*(VU(T)-VU(T-1)))
4610 T=T+1
4620 IF T=NU GOTO 4640
4630 GOTO 4510
4640 IF YU2(NU-1)(MR1 GOTO 4670
4650 IF YU2(NU-1)(MR2 GOTO 4690
4660 GOTO 4700
4670 V2UR=0 : V3UR=0
4675 V1UR=VU(NU-1)
4680 GOTO 4700
4690 V2UR=VU(NU-1) : V3UR=0
4700 ON DIRV GOTO 5110, 4710, 4710
4710 T=1 : HS=1
4720 IF YD1(T)(MG1 GOTO 4810
4730 IF YD1(T)(MG2 GOTO 4790
4740 V2DG=VD(T-1)+((YD1(T)-MG2)/(YD1(T)-YD1(T-1))*(VD(T)-VD(T-1)))
4750 T=ND-1
4760 V3DG=VD(T)
4770 P2G=YD1(T)
4780 GOTO 4850
4790 IF HS=2 GOTO 4820
4800 HS=2
4810 V1DG=VD(T-1)+((YD1(T)-MG1)/(YD1(T)-YD1(T-1))*(VD(T)-VD(T-1)))
4820 T=T+1
4830 IF T=ND GOTO 4850
4840 GOTO 4720
4850 IF YD1(ND-1)(MG1 GOTO 4880
4860 IF YD1(ND-1)(MG2 GOTO 4900
4870 GOTO 4910
4880 V2DG=0 : V3DG=0
```

```
4885 V1DG=VD(ND-1)
4890 GOTO 4910
4900 V2DG=VD(ND-1) : V3DG=0
4910 T=1 : HS=1
4920 IF YD2(T)<MR1 GOTO 5010
4930 IF YD2(T)<MR2 GOTO 4990
4940 V2DR=VD(T-1)+((YD2(T)-MR2)/(YD2(T)-YD2(T-1))*(VD(T)-VD(T-1)))
4950 T=ND-1
4960 V3DR=VD(T)
4970 FDR=YD2(T)
4980 GOTO 5110
4990 IF HS=2 GOTO 5020
5000 HS=2
5010 V1DR=VD(T-1)+((YD2(T)-MR1)/(YD2(T)-YD2(T-1))*(VD(T)-VD(T-1)))
5020 T=T+1
5030 IF T=ND GOTO 5050
5040 GOTO 4920
5050 IF YD2(ND-1)<MR1 GOTO 5080
5060 IF YD2(ND-1)<MR2 GOTO 5100
5070 GOTO 5110
5080 V2DR=0 : V3DR=0
5085 V1DR=VD(ND-1)
5090 GOTO 5110
5100 V2DR=VD(ND-1) : V3DR=0
5110 RETURN
5120 ON DIRV GOTO 5130, 5380, 5130
5130 M=1
5140 N=15
5150 CLS : PRINT
5160 PRINT "     ****** RESULTS FOR UPBOUND VESSEL ******"
5170 PRINT "       VESSEL      GREEN SIDE      RED SIDE "
5180 PRINT "      VELOCITY      DRAWDOWN       DRAWDOWN"
5190 PRINT "      (ft/sec)        (ft)           (ft)   " : PRINT
5200 IF NU<=N THEN N=NU-1
5210 FOR T=M TO N
5220    PRINT USING "        ##.##";VU(T);
5230    PRINT USING "        ##.##  ";YU1(T);
5240    PRINT USING "         ##.##  ";YU2(T)
5250 NEXT T
5260 IF N=NU-1 THEN GOTO 5280
5270 GOTO 5290
5280 PRINT "      CRITICAL"
5290 PRINT
5300 PRINT "HIT SPACE BAR TO CONTINUE."
5310 Q$=INKEY$:IF Q$<>" " THEN GOTO 5310
5320 IF N=NU-1 THEN GOTO 5380
5330 M=M+15
5340 N=N+15
5350 CLS : PRINT
5360 PRINT "     ****** RESULTS FOR UPBOUND VESSEL (cont'd) ******"
5370 GOTO 5170
5380 M=1
5390 N=15
5400 ON DIRV GOTO 5640, 5410, 5410
```

```
5410 CLS : PRINT
5420 PRINT "     ****** RESULTS FOR DOWNBOUND VESSEL ******"
5430 PRINT "       VESSEL      GREEN SIDE      RED SIDE "
5440 PRINT "      VELOCITY      DRAWDOWN       DRAWDOWN"
5450 PRINT "      (ft/sec)        (ft)           (ft)   " : PRINT
5460 IF ND<=N THEN N=ND-1
5470 FOR T=M TO N
5480    PRINT USING "        ##.##";VD(T);
5490    PRINT USING "        ##.## ";YD1(T);
5500    PRINT USING "         ##.## ";YD2(T)
5510 NEXT T
5520 IF N=ND-1 THEN GOTO 5540
5530 GOTO 5550
5540 PRINT "      CRITICAL"
5550 PRINT
5560 PRINT "HIT SPACE BAR TO CONTINUE."
5570 Q$=INKEY$:IF Q$<>" " THEN GOTO 5570
5580 IF N=ND-1 THEN GOTO 5640
5590 M=M+15
5600 N=N+15
5610 CLS : PRINT
5620 PRINT "     ****** RESULTS FOR DOWNBOUND VESSEL (cont'd) ******"
5630 GOTO 5430
5640 CLS : PRINT : PRINT : PRINT : PRINT
5650 INPUT "DO YOU WANT A HARD COPY (Yes,No)";A$
5660 IF LEFT$(A$,1) = "Y" OR LEFT$(A$,1) = "y" THEN GOTO 5780
5670 CLS : PRINT : PRINT : PRINT : PRINT
5680 INPUT "DO YOU WANT TO PLOT RESULTS ON THE SCREEN (Yes,No)";A$
5690 IF LEFT$(A$,1) = "Y" OR LEFT$(A$,1) = "y" THEN GOTO 9080
5700 CLS : PRINT : PRINT : PRINT : PRINT
5710 INPUT "DO YOU WANT TO PLOT RESULTS ON THE HP PLOTTER (Yes,No)";A$
5720 IF LEFT$(A$,1) = "Y" OR LEFT$(A$,1) = "y" THEN GOTO 10170
5730 CLS : PRINT : PRINT : PRINT : PRINT
5740 INPUT "DO YOU WANT TO CHANGE ANY PARAMETERS AND RERUN (Yes,No)";A$
5750 IF LEFT$(A$,1) = "Y" OR LEFT$(A$,1) = "y" THEN GOTO 8010
5760 GOTO 14690 : REM FROM CALCULATING DRAWDOWNS
5770 REM
5780 REM SEND OUTPUT TO PRINTER
5790 REM
5800 CLS:PRINT :PRINT :PRINT :PRINT
5810 PRINT "   PUT PRINTER ON LINE. PLACE PRINTER HEAD" :PRINT
5820 PRINT "   AT THE TOP OF THE PAGE. ":PRINT :PRINT
5830 PRINT "          HIT SPACE BAR TO CONTINUE."
5840 Q$=INKEY$:IF Q$<>" " THEN GOTO 5840
5850 LPRINT:LPRINT:LPRINT:LPRINT:LPRINT
5860 LPRINT CHR$(27);CHR$(88);CHR$(1);CHR$(27);CHR$(87);CHR$(1);
5870 LPRINT " @@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@"
5880 LPRINT
5890 LPRINT "  NAME OF SECTION ## ";Z$
5900 LPRINT
5910 LPRINT " @@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@" : LPRINT
5920 LPRINT CHR$(27);CHR$(87);CHR$(0)
5930 ON DIRV GOTO 5940, 5970, 5940
5940 LPRINT "  AREA ON GREEN SIDE OF UPBOUND VESSEL (sq. ft) =  ",ARE1
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5950 LPRINT "  AREA ON RED SIDE OF UPBOUND VESSEL (sq. ft) =  ",ARE2
5960 ON DIRV GOTO 5990, 5970, 5970
5970 LPRINT "  AREA ON GREEN SIDE OF DOWNBOUND VESSEL (sq. ft) = ",ARE3
5980 LPRINT "  AREA ON RED SIDE OF DOWNBOUND VESSEL (sq. ft) = ",ARE4
5990 LPRINT "  NEARSHORE GREEN - ",NCGR$
6000 LPRINT "  SOIL TYPE GREEN - ",SLGR$
6010 LPRINT "  NEARSHORE RED - ",NCRE$
6020 LPRINT "  SOIL TYPE RED - ",SLRE$
6030 LPRINT "  PERCENTAGE ICE on green side (decimal form) = ",I1
6040 LPRINT "  PERCENTAGE ICE on red side (decimal form) = ",I2
6050 LPRINT "  WIDTH OF WATER SURFACE (ft) =  ",TW
6060 ON DIRV GOTO 6070, 6090, 6070
6070 LPRINT "  DISTANCE TO UPBOUND VESSEL from green side (ft) =",P
6080 ON DIRV GOTO 6100, 6090, 6090
6090 LPRINT "  DISTANCE TO DOWNBOUND VESSEL from green side (ft) =",P1
6100 REM
6110 LPRINT "  VESSEL BEAM (ft) =  ",B
6120 LPRINT "  VESSEL DRAFT (ft) =  ",D
6130 LPRINT "  RIVER VELOCITY (ft per sec.) =  ",V1
6140 ON DIRV GOTO 6150, 6170, 6150
6150 LPRINT "  BEGIN UPBOUND VESSEL VELOCITY (ft per sec.) =  ",VPRU
6160 ON DIRV GOTO 6180, 6170, 6170
6170 LPRINT "  BEGIN DOWNBOUND VESSEL VELOCITY (ft per sec.) =  ",VPRD
6180 LPRINT "  DEPTH AT CENTER OF CHANNEL (ft) =  ",D1 : LPRINT
6190 LPRINT "  ********************************************" : LPRINT
6200 ON DIRV GOTO 6210, 6660, 6210
6210 ON RUNU GOTO 6220,6310
6220 LPRINT "  THE CALCULATION REACHED CRITICAL CONDITIONS "
6230 THENU
6240 ON CRITU GOTO 6250, 6280
6250 LPRINT USING "  ON THE GREEN SIDE OF THE UPBOUND VESSEL AT ##.## ";VU(T);
6260 LPRINT "ft/sec" : LPRINT : LPRINT
6270 GOTO 6340
6280 LPRINT USING "  ON THE RED SIDE OF THE UPBOUND VESSEL AT ##.## ";VU(T);
6290 LPRINT "ft/sec" : LPRINT : LPRINT
6300 GOTO 6340
6310 THENU
6320 LPRINT : LPRINT USING "  THE UPBOUND VESSEL IS GROUNDED AT ##.## ";VU(T);
6330 LPRINT "ft/sec" : LPRINT : LPRINT
6340 LPRINT "   DAMAGE PROBABILITY GREEN SIDE IS":LPRINT
6350 IF V2UG=0 THEN GOTO 6390
6360 LPRINT USING "       NONE TO LIGHT FROM 0 ft/sec to ##.## ";V1UG;
6370 LPRINT "ft/sec"
6380 GOTO 6410
6390 LPRINT "       NONE TO LIGHT from 0 ft/sec to CRITICAL": LPRINT :LPRINT
6400 GOTO 6500
6410 IF V3UG=0 THEN GOTO 6480
6420 LPRINT USING "       MODERATE from ##.## ";V1UG;
6430 LPRINT USING "ft/sec to ##.## ";V2UG;
6440 LPRINT "ft/sec"
6450 LPRINT USING "       SEVERE above ##.## ";V2UG;
6460 LPRINT "ft/sec"
6470 GOTO 6500
6480 LPRINT USING "       MODERATE above ##.## ";V2UG;
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6490 LPRINT "ft/sec":LPRINT
6500 LPRINT:LPRINT "   DAMAGE PROBABILITY RED SIDE IS":LPRINT
6510 IF V2UR=0 THEN GOTO 6550
6520 LPRINT USING "    NONE TO LIGHT FROM 0 ft/sec to ##.## ";V1UR;
6530 LPRINT "ft/sec"
6540 GOTO 6570
6550 LPRINT "    NONE TO LIGHT from 0 ft/sec to CRITICAL":LPRINT :LPRINT
6560 GOTO 6660
6570 IF V3UR=0 THEN GOTO 6640
6580 LPRINT USING "    MODERATE from ##.## ";V1UR;
6590 LPRINT USING "ft/sec to ##.## ";V2UR;
6600 LPRINT "ft/sec"
6610 LPRINT USING "    SEVERE above ##.## ";V2UR;
6620 LPRINT "ft/sec"
6630 GOTO 6660
6640 LPRINT USING "    MODERATE above ##.## ";V2UR;
6650 LPRINT "ft/sec":LPRINT
6660 ON DIRV GOTO 7120, 6670, 6670
6670 ON RUND GOTO 6680,6770
6680 LPRINT :LPRINT "  THE CALCULATION REACHED CRITICAL CONDITIONS "
6690 END
6700 ON CRITD GOTO 6710, 6740
6710 LPRINT USING "  ON THE GREEN SIDE OF THE DOWNBOUND VESSEL AT ##.## ";VD(T);
6720 LPRINT "ft/sec" : LPRINT : LPRINT
6730 GOTO 6800
6740 LPRINT USING "  ON THE RED SIDE OF THE DOWNBOUND VESSEL AT ##.## ";VD(T);
6750 LPRINT "ft/sec" : LPRINT : LPRINT
6760 GOTO 6800
6770 END
6780 LPRINT : LPRINT USING "  THE DOWNBOUND VESSEL IS GROUNDED AT ##.## ";VD(T);
6790 LPRINT "ft/sec" : LPRINT : LPRINT
6800 LPRINT "   DAMAGE PROBABILITY GREEN SIDE IS":LPRINT
6810 IF V2DG=0 THEN GOTO 6850
6820 LPRINT USING "       NONE TO LIGHT FROM 0 ft/sec to ##.## ";V1DG;
6830 LPRINT "ft/sec"
6840 GOTO 6870
6850 LPRINT "       NONE TO LIGHT from 0 ft/sec to CRITICAL": LPRINT :LPRINT
6860 GOTO 6960
6870 IF V3DG=0 THEN GOTO 6940
6880 LPRINT USING "       MODERATE from ##.## ";V1DG;
6890 LPRINT USING "ft/sec to ##.## ";V2DG;
6900 LPRINT "ft/sec"
6910 LPRINT USING "       SEVERE above ##.## ";V2DG;
6920 LPRINT "ft/sec"
6930 GOTO 6960
6940 LPRINT USING "       MODERATE above ##.## ";V2DG;
6950 LPRINT "ft/sec":LPRINT
6960 LPRINT:LPRINT "   DAMAGE PROBABILITY RED SIDE IS":LPRINT
6970 IF V2DR=0 THEN GOTO 7010
6980 LPRINT USING "    NONE TO LIGHT FROM 0 ft/sec to ##.## ";V1DR;
6990 LPRINT "ft/sec"
7000 GOTO 7030
7010 LPRINT "    NONE TO LIGHT from 0 ft/sec to CRITICAL":LPRINT :LPRINT
7020 GOTO 7120
```

```
7030 IF V3DR=0 THEN GOTO 7100
7040 LPRINT USING "    MODERATE from ##.## ";V1DR;
7050 LPRINT USING "ft/sec to ##.## ";V2DR;
7060 LPRINT "ft/sec"
7070 LPRINT USING "    SEVERE above ##.## ";V2DR;
7080 LPRINT "ft/sec"
7090 GOTO 7120
7100 LPRINT USING "    MODERATE above ##.## ";V2DR;
7110 LPRINT "ft/sec":LPRINT
7120 FOR I=1 TO 9
7130 LPRINT
7140 NEXT I
7150 ON DIRV GOTO 7160, 7160, 7190
7160 FOR I=1 TO 12
7170 LPRINT
7180 NEXT I
7190 LPRINT : LPRINT : LPRINT : LPRINT : LPRINT
7200 ON DIRV GOTO 7210, 7620, 7210
7210 LPRINT CHR$(27);CHR$(88);CHR$(1);CHR$(27);CHR$(87);CHR$(1);
7220 LPRINT "  @@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@" : LPRINT
7230 LPRINT "       RESULTS FOR UPBOUND VESSEL " : LPRINT
7240 LPRINT "  @@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@" : LPRINT
7250 LPRINT CHR$(27);CHR$(87);CHR$(0)
7260 LPRINT
7270 M=1
7280 N=40
7290 GOTO 7360
7300 LPRINT CHR$(27);CHR$(87);CHR$(1);
7310 LPRINT "  @@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@" : LPRINT
7320 LPRINT "   RESULTS FOR UPBOUND VESSEL (con't)" : LPRINT
7330 LPRINT " @@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@" : LPRINT
7340 LPRINT CHR$(27);CHR$(87);CHR$(0)
7350 LPRINT
7360 LPRINT "                    VESSEL       GREEN SIDE       RED SIDE"
7370 LPRINT "                   VELOCITY       DRAWDOWN        DRAWDOWN"
7380 LPRINT "                   (ft/sec)         (ft)            (ft) "
7390 IF NU<=N THEN N=NU-1
7400 LPRINT
7410 FOR T=M TO N
7420 LPRINT USING "                  ##.##       ";VU(T);
7430 LPRINT USING "    ##.##          ";YU1(T);
7440 LPRINT USING "  ##.##      ";YU2(T)
7450 NEXT T
7460 IF N=NU-1 THEN GOTO 7480
7470 GOTO 7530
7480 ON RUNU GOTO 7490, 7510
7490 LPRINT "                 CRITICAL      "
7500 GOTO 7520
7510 LPRINT "          VESSEL IS GROUNDED "
7520 GOTO 7570
7530 M=M+1
7540 N=N+44
7550 LPRINT:LPRINT:LPRINT:LPRINT:LPRINT:LPRINT:LPRINT:LPRINT:LPRINT:LPRINT
7560 GOTO 7300
```

```
7570 Z=49-NU
7580 FOR I=1 TO Z
7590 LPRINT
7600 NEXT I
7610 ON DIRV GOTO 7990, 7620, 7620
7620 LPRINT:LPRINT:LPRINT:LPRINT:LPRINT
7630 LPRINT CHR$(27);CHR$(88);CHR$(1);CHR$(27);CHR$(87);CHR$(1);
7640 LPRINT "  @@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@" : LPRINT
7650 LPRINT "      RESULTS FOR DOWNBOUND VESSEL " : LPRINT
7660 LPRINT "  @@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@" : LPRINT
7670 LPRINT CHR$(27);CHR$(87);CHR$(0)
7680 LPRINT
7690 M=1
7700 N=40
7710 GOTO 7780
7720 LPRINT CHR$(27);CHR$(87);CHR$(1);
7730 LPRINT "  @@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@" : LPRINT
7740 LPRINT "  RESULTS FOR DOWNBOUND VESSEL (con't)" : LPRINT
7750 LPRINT "  @@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@" : LPRINT
7760 LPRINT CHR$(27);CHR$(87);CHR$(0)
7770 LPRINT
7780 LPRINT "                     VESSEL       GREEN SIDE        RED SIDE"
7790 LPRINT "                    VELOCITY       DRAWDOWN         DRAWDOWN"
7800 LPRINT "                    (ft/sec)         (ft)             (ft) "
7810 IF ND<=N THEN N=ND-1
7820 LPRINT
7830 FOR T=M TO N
7840 LPRINT USING "                     ##.##       ";VD(T);
7850 LPRINT USING "     ##.##           ";YD1(T);
7860 LPRINT USING "  ##.##      ";YD2(T)
7870 NEXT T
7880 IF N=ND-1 THEN GOTO 7900
7890 GOTO 7950
7900 ON RUND GOTO 7910, 7930
7910 LPRINT "                CRITICAL      "
7920 GOTO 7940
7930 LPRINT "            VESSEL IS GROUNDED "
7940 GOTO 7990
7950 M=N+1
7960 N=N+44
7970 LPRINT:LPRINT:LPRINT:LPRINT:LPRINT:LPRINT:LPRINT:LPRINT:LPRINT:LPRINT
7980 GOTO 7720
7990 GOTO 5670  :  REM FROM PRINTING OUTPUT
8000 REM
8010 REM TO CHANGE DATA
8020 REM
8030 AREA1=ARE1
8040 AREA2=ARE2
8050 AREA3=ARE3
8060 AREA4=ARE4
8070 CLS:PRINT:PRINT:PRINT
8080 PRINT "THE FOLLOWING MENU ALLOWS FOR CHANGES IN THE DATA JUST RUN"
8090 PRINT:PRINT
8100 PRINT "INPUT OPTION # OF PARAMETER YOU WANT TO CHANGE."
```

```
8110 PRINT:PRINT
8120 PRINT "THE OPTIONS ARE BROKEN INTO 2 LISTS"
8130 PRINT:PRINT
8140 PRINT "OPTION '0' WILL RECALCULATE THE DRAWDOWNS WITH THE NUMBERS CHANGED"
8150 PRINT:PRINT
8160 PRINT "HIT SPACE BAR TO CONTINUE."
8170 Q$=INKEY$:IF Q$()" " THEN GOTO 8170
8180 CLS
8190 PRINT
8200 PRINT 0, "RECALCULATE DRAWDOWNS WITH DATA CHANGED"
8210 PRINT
8220 PRINT 1, "AREA ON GREEN SIDE OF UPBOUND VESSEL"
8230 PRINT
8240 PRINT 2, "AREA ON RED SIDE OF UPBOUND VESSEL"
8250 PRINT
8260 PRINT 3, "AREA ON GREEN SIDE OF DOWNBOUND VESSEL"
8270 PRINT
8280 PRINT 4, "AREA ON RED SIDE OF DOWNBOUND VESSEL"
8290 PRINT
8300 PRINT 5, "PERCENTAGE ICE ON GREEN SIDE"
8310 PRINT
8320 PRINT 6, "PERCENTAGE ICE ON RED SIDE"
8330 PRINT
8340 PRINT 7, "DISTANCE TO UPBOUND VESSEL"
8350 PRINT
8360 PRINT 8, "DISTANCE TO DOWNBOUND VESSEL"
8370 PRINT
8380 PRINT 9, "SECOND LIST OF INPUT DATA"
8390 PRINT:INPUT "                                    OPTION #    ";OPT
8400 IF OPT = 0 THEN GOTO 8460
8410 IF OPT=9 GOTO 8470
8420 IF (OPT(1) OR (OPT)9) THEN PRINT "BAD OPTION # " : GOTO 8070
8430 CLS:PRINT:PRINT:PRINT:PRINT:PRINT
8440 ON OPT GOSUB 8730,8760,8790,8820,8850,8870,8910,8930,8470
8450 GOTO 8180
8460 GOTO 1720
8470 CLS :PRINT
8480 PRINT 0, "RECALCULATE DRAWDOWNS WITH DATA CHANGED"
8490 PRINT
8500 PRINT 1, "WIDTH OF WATER SURFACE"
8510 PRINT
8520 PRINT 2, "VESSEL BEAM"
8530 PRINT
8540 PRINT 3, "VESSEL DRAFT"
8550 PRINT
8560 PRINT 4, "RIVER VELOCITY"
8570 PRINT
8580 PRINT 5, "UPBOUND VESSEL VELOCITY"
8590 PRINT
8600 PRINT 6, "DOWNBOUND VESSEL VELOCITY"
8610 PRINT
8620 PRINT 7, "DEPTH AT CENTER OF CHANNEL"
8630 PRINT
8640 PRINT 8, "FIRST LIST OF INPUT DATA"
```

```
8650 PRINT:INPUT "                                        OPTION #    ";OPT
8660 IF OPT=0 THEN GOTO 8460
8670 IF OPT=8 GOTO 8180
8680 IF(OPT(1) OR (OPT)8) THEN PRINT "BAD OPTION #":GOTO 5890
8690 CLS
8700 PRINT:PRINT:PRINT:PRINT:PRINT
8710 ON OPT GOSUB 8890,8950,8970,8990,9010,9030,9050,8180
8720 GOTO 8180
8730 PRINT:INPUT "AREA ON GREEN SIDE OF UPBOUND VESSEL in sq. ft. = ";AREA1
8740 ARE1=AREA1
8750 RETURN
8760 PRINT:INPUT "AREA ON RED SIDE OF UPBOUND VESSEL in sq. ft. = ";AREA2
8770 ARE2=AREA2
8780 RETURN
8790 PRINT:INPUT "AREA ON GREEN SIDE OF DOWNBOUND VESSEL in sq. ft. = ";AREA3
8800 ARE3=AREA3
8810 RETURN
8820 PRINT:INPUT "AREA ON RED SIDE OF DOWNBOUND VESSEL in sq. ft. = ";AREA4
8830 ARE4=AREA4
8840 RETURN
8850 PRINT:INPUT "PERCENTAGE ICE on the green side (decimal form) = ";I1
8860 RETURN
8870 PRINT:INPUT "PERCENTAGE ICE on the red side (decimal form) = ";I2
8880 RETURN
8890 PRINT:INPUT "WIDTH OF WATER SURFACE in feet = ";TW
8900 RETURN
8910 PRINT:INPUT "DISTANCE TO UPBOUND VESSEL from green side in feet = ";P
8920 RETURN
8930 PRINT:INPUT "DISTANCE TO DOWNBOUND VESSEL from green side in feet = ";P1
8940 RETURN
8950 PRINT:INPUT "VESSEL BEAM in feet = ";B
8960 RETURN
8970 PRINT:INPUT "VESSEL DRAFT in feet = ";D
8980 RETURN
8990 PRINT:INPUT "RIVER VELOCITY in feet per sec. = ";V1
9000 RETURN
9010 PRINT:INPUT "UPBOUND VESSEL VELOCITY in feet per sec. = ";V2UP
9020 RETURN
9030 PRINT:INPUT "DOWNBOUND VESSEL VELOCITY in feet per sec. = ";V2DP
9040 RETURN
9050 PRINT:INPUT "DEPTH AT CENTER OF CHANNEL in feet = ";D1
9060 RETURN
9070 REM
9080 REM PLOT RESULTS ON SCREEN
9090 REM
9100 ON DIRV GOTO 9110, 9130, 9110
9110 NUM = 1
9120 GOTO 9140
9130 NUM=3
9140 FOR T=1 TO NU-1
9150 YSC1(T)=YU1(T)
9160 VSC(T)=VU(T)
9170 YSC2(T)=YU2(T)
9180 NEXT T
```

```
9190 FOR T=1 TO ND-1
9200 YSC3(T)=YD1(T)
9210 VDSC(T)=VD(T)
9220 YSC4(T)=YD2(T)
9230 NEXT T
9240 CLS
9250 KEY OFF
9260 SCREEN 1
9270 COLOR 0,3
9280 PSET(44,4),1
9290 FOR Z=1 TO 10
9300 DRAW "L3 R3 D16"
9310 NEXT Z
9320 DRAW "L3 R3 D3 U3"
9330 FOR Z=1 TO 10
9340 DRAW "R22 D3 U3"
9350 NEXT Z
9360 FOR Z=1 TO 10
9370 DRAW "R3 L3 U16"
9380 NEXT Z
9390 DRAW "R3 L3 U3 D3"
9400 FOR Z=1 TO 10
9410 DRAW "L22 U3 D3"
9420 NEXT Z
9430 LOCATE 1,4 : PRINT "5"
9440 LOCATE 5,4 : PRINT "4"
9450 LOCATE 9,4 : PRINT "3"
9460 LOCATE 13,4 : PRINT "2"
9470 LOCATE 17,4 : PRINT "1"
9480 LOCATE 21,4 : PRINT "0"
9490 LOCATE 8,2 : PRINT "D"
9500 LOCATE 9,2 : PRINT "R"
9510 LOCATE 10,2 : PRINT "A"
9520 LOCATE 11,2 : PRINT "W"
9530 LOCATE 12,2 : PRINT "D"
9540 LOCATE 13,2 : PRINT "O"
9550 LOCATE 14,2 : PRINT "W"
9560 LOCATE 15,2 : PRINT "N"
9570 LOCATE 17,2 : PRINT "f"
9580 LOCATE 18,2 : PRINT "t"
9590 LOCATE 22,6 : PRINT "0     4     8     12     16     20"
9600 LOCATE 24,14 : PRINT "VELOCITY (ft/s)"
9610 ON NUM GOTO 9620, 9730, 9830, 9940, 10030
9620 FOR T=1 TO NU-1
9630 YU1(T)=158-YU1(T)*32
9640 VU(T)=44+VU(T)*11
9650 PSET (VU(T),YU1(T))
9660 DRAW "BM+2,+2U4L4D4R4"
9670 NEXT T
9680 LOCATE 1,8 : PRINT Z$
9690 LOCATE 3,8 : PRINT "GREEN - UPBOUND"
9700 NUM = 2
9710 IF INKEY$ = "" THEN GOTO 9710
9720 GOTO 9240
```

```
9730 FOR T=1 TO NU-1
9740 YU2(T)=158-YU2(T)*32
9750 PSET (VU(T),YU2(T))
9760 DRAW "BM+2,+2U4L4D4R4"
9770 NEXT T
9780 LOCATE 1,8 : PRINT Z$
9790 LOCATE 3,8 : PRINT "RED - UPBOUND"
9800 NUM = 3
9810 IF INKEY$ = "" THEN GOTO 9810
9820 ON DIRV GOTO 10030, 9240, 9240
9830 FOR T=1 TO ND-1
9840 YD1(T)=158-YD1(T)*32
9850 VD(T)=44+VD(T)*11
9860 PSET (VD(T),YD1(T))
9870 DRAW "BM+2,+2U4L4D4R4"
9880 NEXT T
9890 LOCATE 1,8 : PRINT Z$
9900 LOCATE 3,8 : PRINT "GREEN - DOWNBOUND"
9910 NUM = 4
9920 IF INKEY$ = "" THEN GOTO 9920
9930 GOTO 9240
9940 FOR T=1 TO ND-1
9950 YD2(T)=158-YD2(T)*32
9960 PSET (VD(T),YD2(T))
9970 DRAW "BM+2,+2U4L4D4R4"
9980 NEXT T
9990 LOCATE 1,8 : PRINT Z$
10000 LOCATE 3,8 : PRINT "RED - DOWNBOUND"
10010 NUM = 5
10020 IF INKEY$ = "" THEN GOTO 10020
10030 SCREEN 0
10040 WIDTH 80
10050 FOR T=1 TO NU-1
10060 YU1(T)=YSC1(T)
10070 VU(T)=VUSC(T)
10080 YU2(T)=YSC2(T)
10090 NEXT T
10100 FOR T=1 TO ND-1
10110 YD1(T)=YSC3(T)
10120 VD(T)=VDSC(T)
10130 YD2(T)=YSC4(T)
10140 NEXT T
10150 GOTO 5700 : REM FROM PLOT
10160 REM
10170 REM SEND RESULTS TO PLOTTER
10180 REM
10190 OPEN "COM1:9600,S,7,1,RS,CS65535,DS,CD" AS #1
10200 ON DIRV GOTO 10210, 10240, 10210
10210 DIR=1
10220 DST=P
10230 GOTO 10260
10240 DIR=2
10250 DST=P1
10260 FOR T=1 TO NU-1
```

```
10270 YSC1(T)=YU1(T)
10280 VUSC(T)=VU(T)
10290 YSC2(T)=YU2(T)
10300 NEXT T
10310 CALU=1 : CALD=1
10320 FOR T=1 TO ND-1
10330 YSC3(T)=YD1(T)
10340 VDSC(T)=VD(T)
10350 YSC4(T)=YD2(T)
10360 NEXT T
10370 CLS : PRINT : PRINT : PRINT
10380 PRINT "CHOOSE ONE OF THE FOLLOWING OPTIONS" :PRINT
10390 PRINT "DRAW GRAPH OF" : PRINT
10400 PRINT 1, "DRAWDOWNS ONLY" : PRINT
10410 PRINT 2, "DAMAGE PROBABILITY ONLY" : PRINT
10420 PRINT 3, "BOTH DRAWDOWNS & DAMAGE PROBABILITY" : PRINT : PRINT
10430 INPUT "                    INPUT OPTION  ";SELE
10440 IF (SELE(1) OR (SELE)3) THEN GOTO 10370
10450 ON SELE GOTO 10460, 10460, 10460
10460 CLS : PRINT : PRINT : PRINT
10470 PRINT "CHOOSE ONE OF THE FOLLOWING OPTIONS" :PRINT
10480 PRINT "DRAW GRAPH OF" : PRINT
10490 PRINT 1, "GREEN SIDE ONLY" : PRINT
10500 PRINT 2, "RED SIDE ONLY" : PRINT
10510 PRINT 3, "BOTH SIDES ON SAME GRAPH" : PRINT : PRINT
10520 INPUT "                    INPUT OPTION  ";SIDE
10530 IF (SIDE(1) OR (SIDE)3) THEN GOTO 10460
10540 CLS:PRINT :PRINT :PRINT :PRINT :PRINT
10550 PRINT "PUT PLOTTER ON LINE - REPLACE PAPER" :PRINT
10560 PRINT "INSERT THICK BLACK PEN FOR PEN #1" :PRINT
10570 PRINT "INSERT FINE BLACK PEN FOR PEN #2" :PRINT
10580 PRINT :PRINT :PRINT
10590 PRINT "HIT SPACE BAR TO CONTINUE."
10600 G$=INKEY$:IF G$() " " THEN GOTO 10600
10610 ON SELE GOTO 10620, 10640, 10620
10620 PRINT #1, "IN;SP1;PA1500,6480;PD"
10630 GOTO 10660
10640 PRINT #1, "IN;SP1;PA1500,1500;PD"
10650 GOTO 10700
10660 FOR I=1 TO 6
10670 PRINT #1, "IN;YT;PD;PR0,-830;PU"
10680 NEXT I
10690 PRINT #1, "IN;YT"
10700 FOR I=1 TO 8
10710 PRINT #1, "IN;XT;PD;PR875,0;PU"
10720 NEXT I
10730 PRINT #1, "IN;XT"
10740 PRINT #1, "IN;CP-1,-1;LB16" + CHR$(3)
10750 PRINT #1, "CP"
10760 PRINT #1, "IN;PA6750,1500"
10770 PRINT #1, "IN;CP-1,-1;LB12" + CHR$(3)
10780 PRINT #1, "CP"
10790 PRINT #1, "IN;PA5000,1500"
10800 PRINT #1, "IN;CP-1,-1;LB 8" + CHR$(3)
```

```
10810 PRINT #1, "CP"
10820 PRINT #1, "IN;PA3250,1500"
10830 PRINT #1, "IN;CP-1,-1;LB 4" + CHR$(3)
10840 PRINT #1, "CP"
10850 PRINT #1, "IN;PA1500,1500"
10860 PRINT #1, "IN;CP-1,-1;LB 0" + CHR$(3)
10870 PRINT #1, "CP"
10880 ON SELE GOTO 10890, 11010, 10890
10890 PRINT #1, "IN;PA1500,1500"
10900 PRINT #1, "IN;CP-2,-0.1;LB0" + CHR$(3)
10910 PRINT #1, "CP"
10920 PRINT #1, "IN;PA1500,3160"
10930 PRINT #1, "IN;CP-2,-0.1;LB1" + CHR$(3)
10940 PRINT #1, "CP"
10950 PRINT #1, "IN;PA1500,4820"
10960 PRINT #1, "IN;CP-2,-0.1;LB2" + CHR$(3)
10970 PRINT #1, "CP"
10980 PRINT #1, "IN;PA1500,6480"
10990 PRINT #1, "IN;CP-2,-0.1;LB3" + CHR$(3)
11000 PRINT #1, "CP;PU"
11010 ON SELE GOTO 11040, 11020, 11020
11020 PRINT #1, "IN;PA700,6480;PD;"
11030 PRINT #1, "PA700,1500;PU;"
11040 ON SELE GOTO 11080, 11110, 11050
11050 PRINT #1, "IN;PA2000,7000;"
11060 PRINT #1, "SI.3,.7,LB**DRAWDOWN + DAMAGE vs VESSEL SPEED**" + CHR$(3)
11070 GOTO 11130
11080 PRINT #1, "IN;PA3000,7000;"
11090 PRINT #1, "SI.3,.7,LB**DRAWDOWN vs VESSEL SPEED**" + CHR$(3)
11100 GOTO 11130
11110 PRINT #1, "IN;PA3000,7000;"
11120 PRINT #1, "SI.3,.7,LB**DAMAGE vs VESSEL SPEED**" + CHR$(3)
11130 PRINT #1, "IN;PA4475,1100"
11140 PRINT #1, "LBVESSEL SPEED (ft/sec)" + CHR$(3)
11150 ON SELE GOTO 11160, 11190, 11160
11160 PRINT #1, "IN;PA1200,3250"
11170 PRINT #1, "DI0,1;LBDRAWDOWN (ft)" + CHR$(3)
11180 ON SELE GOTO 11210, 11190, 11190
11190 PRINT #1, "IN;PA420,1900"
11200 PRINT #1, "DI0,1;LBSHORE AND NEARSHORE DAMAGE PROBABILITY" + CHR$(3)
11210 PRINT #1, "IN;SP2;PA1750,6700"
11220 ON SIDE GOTO 11230, 11250, 11270
11230 PRINT #1, "LBSITE: "Z$ "- GREEN SIDE"+ CHR$(3)
11240 GOTO 11280
11250 PRINT #1, "LBSITE: "Z$ "- RED SIDE"+ CHR$(3)
11260 GOTO 11280
11270 PRINT #1, "LBSITE: "Z$ "- BOTH SIDES"+ CHR$(3)
11280 PRINT #1, "IN;PA1750,6350"
11290 IF DIR = 2 GOTO 11320
11300 PRINT #1, "LBUPBOUND VESSEL " + CHR$(3)
11310 GOTO 11330
11320 PRINT #1, "LBDOWNBOUND VESSEL " + CHR$(3)
11330 REM
11340 REM
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```
11350 PRINT #1, "IN;PA1750,6050"
11360 PRINT #1, "LBVESSEL BEAM ="B "ft"+ CHR$(3)
11370 PRINT #1, "IN;PA1750,5900"
11380 PRINT #1, "LBVESSEL DRAFT ="D "ft"+ CHR$(3)
11390 PRINT #1, "IN;PA1750,5750"
11400 PRINT #1, "LBDIST TO VESSEL (green) ="DST "ft"+ CHR$(3)
11410 ON SELE GOTO 11520, 11420, 11420
11420 ON SIDE GOTO 11430, 11480, 11430
11430 PRINT #1, "IN;PA1750,5500"
11440 PRINT #1, "LBSHORE(gr.)="NCGR$"" + CHR$(3)
11450 PRINT #1, "IN;PA1750,5350"
11460 PRINT #1, "LBSOIL(gr.)="SLGR$"" + CHR$(3)
11470 ON SIDE GOTO 11520, 11480, 11480
11480 PRINT #1, "IN;PA1750,5200"
11490 PRINT #1, "LBSHORE(red)="NCRE$"" + CHR$(3)
11500 PRINT #1, "IN;PA1750,5050"
11510 PRINT #1, "LBSOIL(red)="SLRE$"" + CHR$(3)
11520 ON SELE GOTO 11630, 11530, 11530
11530 PRINT #1, "IN;PA7000,6500"
11540 PRINT #1, "LBSHORE AND NEARSHORE "+ CHR$(3)
11550 PRINT #1, "IN;PA7000,6350"
11560 PRINT #1, "LBDAMAGE PROBABILITY  "+ CHR$(3)
11570 PRINT #1, "IN;PA7100,6100"
11580 PRINT #1, "LBA = NONE TO LIGHT  "+ CHR$(3)
11590 PRINT #1, "IN;PA7100,5950"
11600 PRINT #1, "LBB = MODERATE  "+ CHR$(3)
11610 PRINT #1, "IN;PA7100,5800"
11620 PRINT #1, "LBC = HIGH  "+ CHR$(3)
11630 PRINT #1, "IN;PA7000,1950"
11640 PRINT #1, "LBRIVER VEL.="V1"ft/sec" + CHR$(3)
11650 ON SELE GOTO 11690, 11660, 11660
11660 ON SIDE GOTO 11690, 11690, 11670
11670 PRINT #1, "IN;PA6400,500"
11680 PRINT #1, "LBDAMAGE BOTH SIDES " + CHR$(3)
11690 IF ITH = 0 GOTO 11720
11691 ITT = ITH*10
11692 IB = INT(ITT)
11693 IC = IB/10
11700 PRINT #1, "IN;PA7000,1750"
11710 PRINT #1, "LBAVG ICE THICK = "IC "in."+ CHR$(3)
11720 PRINT #1, "PU;SP0;"
11730 CLS:PRINT :PRINT :PRINT :PRINT :PRINT
11740 PRINT "WHEN PLOTTER PAUSES -" : PRINT
11750 PRINT "INSERT GREEN PEN FOR PEN #1" :PRINT
11760 PRINT "INSERT RED PEN FOR PEN #2" :PRINT
11770 PRINT :PRINT :PRINT
11780 PRINT "HIT SPACE BAR TO CONTINUE."
11790 Q$=INKEY$:IF Q$() " " THEN GOTO 11790
11800 IF DIR=2 GOTO 14190
11810 ON SIDE GOTO 11820, 12170, 11840
11820 PRINT #1, "IN;SP1;PA4450,800"
11830 GOTO 11850
11840 PRINT #1, "IN;SP1;PA3000,800"
11850 ON SELE GOTO 11860, 11880, 11860
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11860 PRINT #1, "LBDRAWDOWN GREEN SIDE #" + CHR$(3)
11870 ON SELE GOTO 12100, 11880, 11880
11880 ON SIDE GOTO 11890, 12170, 11910
11890 PRINT #1, "PR4450,500"
11900 GOTO 11920
11910 PRINT #1, "PR1000,500"
11920 PRINT #1, "LBDAMAGE GREEN SIDE " + CHR$(3)
11930 ON SIDE GOTO 11940, 12170, 11990
11940 PRINT #1, "IW";6450;400;6950;600
11950 FOR Y=0 TO 600 STEP 100
11960 PRINT #1, "PU";6450;Y;"PD";6950;Y+500
11970 NEXT Y
11980 GOTO 12030
11990 PRINT #1, "IW";3000;400;3500;600
12000 FOR Y=0 TO 600 STEP 100
12010 PRINT #1, "PU";3000;Y;"PD";3500;Y+500
12020 NEXT Y
12030 PRINT #1, "PU;IW"
12040 ON SIDE GOTO 12100, 12170, 12050
12050 PRINT #1, "IW";8400;400;8900;600
12060 FOR Y=0 TO 600 STEP 100
12070 PRINT #1, "PU";8400;Y;"PD";8900;Y+500
12080 NEXT Y
12090 PRINT #1, "PU;IW"
12100 ON SELE GOTO 12110, 12180, 12110
12110 IF DIR=2 GOTO 14120
12120 FOR T=1 TO NU-1
12130 VU(T)=((VU(T)/16)*7000)+1500
12140 YU1(T)=((YU1(T)/3)*5000)+1500
12150 PRINT #1, "IN;SM*;PA",VU(T),",",YU1(T)," + CHR$(3)
12160 NEXT T
12170 ON SELE GOTO 13050, 12180, 12180
12180 IF DIR=2 GOTO 12410
12190 IF CALU=2 GOTO 12410
12191 IF MG1=100 THEN MG1=2
12192 IF MR1=100 THEN MR1=2
12193 IF MG2=100 THEN MG2=2
12194 IF MR2=100 THEN MR2=2
12200 MG=((V1UG/16)*7000)+1500
12210 MR=((V1UR/16)*7000)+1500
12220 IG=((MG1/3)*5000)+1500
12230 IR=((MR1/3)*5000)+1500
12240 NG=((V2UG/16)*7000)+1500
12250 NR=((V2UR/16)*7000)+1500
12252 IF V2UG=0 THEN NG=0
12254 IF V2UR=0 THEN NR=0
12260 KG=1500
12270 KR=1500
12280 RG=((V3UG/16)*7000)+1500
12290 RR=((V3UR/16)*7000)+1500
12292 IF V3UG=0 THEN RG=0
12294 IF V3UR=0 THEN RR=0
12300 JG=((MG2/3)*5000)+1500
12310 JR=((MR2/3)*5000)+1500
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12320 D=250
12330 LUG=((PUG/3)*5000)+1500
12340 LUR=((PUR/3)*5000)+1500
12350 IF LUG)LUR THEN GOTO 12390
12360 IF LUR)=LUG THEN GOTO 12370
12370 LUG=LUR
12380 GOTO 12400
12390 LUR=LUG
12400 CALL = 2
12410 ON SIDE GOTO 12420, 13050, 12420
12420 ON SELE GOTO 13050, 12430, 12430
12430 PRINT #1, "IN;PA500,900"
12440 PRINT #1, "DIO,1;LBGREEN " + CHR$(3)
12450 X=700 : Y=IG
12460 PRINT #1, "IN;PA",X,",",Y,";PD;"
12470 X=500
12480 PRINT #1, "PA",X,",",Y,";PU;"
12490 X=700 : Y=JG
12500 PRINT #1, "IN;PA",X,",",Y,";PD;"
12510 X=500
12520 PRINT #1, "PA",X,",",Y,";PU;"
12530 X=650 : Y=1480+((IG-KG)/2)
12540 PRINT #1, "IN;PA",X,",",Y,";PU;"
12550 PRINT #1, "DIO,1;LBA " + CHR$(3)
12560 IF NG=0 GOTO 12640
12570 X=650 : Y=IG+((JG-IG)/2)-20
12580 PRINT #1, "IN;PA",X,",",Y,";PU;"
12590 PRINT #1, "DIO,1;LBB " + CHR$(3)
12600 IF RG=0 GOTO 12640
12610 X=650 : Y=JG+((LUG-JG)/2)
12620 PRINT #1, "IN;PA",X,",",Y,";PU;"
12630 PRINT #1, "DIO,1;LBC " + CHR$(3)
12640 X=MG : Y=KG
12650 PRINT #1, "IN;PA",X,",",Y,";PD;"
12660 Y=IG
12670 PRINT #1, "PA",X,",",Y,";PD;"
12680 X=KG
12690 PRINT #1, "PA",X,",",Y,";PD;"
12700 Y=KG
12710 PRINT #1, "PA",X,",",Y,";PU;"
12720 PRINT #1, "IW";KG;KG;MG;IG
12730 FOR Y=KG-(MG-KG) TO IG STEP R
12740 PRINT #1, "PU";KG;Y;"PD";MG;Y+(MG-KG)
12750 NEXT Y
12760 PRINT #1, "PU;IW"
12770 IF NG=0 GOTO 13080
12780 X=NG : Y=KG
12790 PRINT #1, "IN;PA",X,",",Y,";PD;"
12800 Y=JG
12810 PRINT #1, "PA",X,",",Y,";PD;"
12820 X=NG
12830 PRINT #1, "PA",X,",",Y,";PD;"
12840 Y=KG
12850 PRINT #1, "PA",X,",",Y,";PD;"
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12860 PRINT #1, "IW";MG;KG;NG;JG
12870 FOR Y=KG-(NG-MG) TO JG STEP Q
12880 PRINT #1, "PU";MG;Y;"PD";NG;Y+(NG-MG)
12890 NEXT Y
12900 PRINT #1, "PU;IW"
12910 IF RG=0 GOTO 13080
12920 X=NG : Y=KG
12930 PRINT #1, "PA",X,",",Y,";PD;"
12940 Y=LUG
12950 PRINT #1, "PA",X,",",Y,";PD;"
12960 X=RG
12970 PRINT #1, "PA",X,",",Y,";PD;"
12980 Y=KG
12990 PRINT #1, "PA",X,",",Y,";PU;"
13000 PRINT #1, "IW";NG;KG;RG;LUG
13010 FOR Y=KG-(RG-NG) TO LUG STEP Q
13020 PRINT #1, "PU";NG;Y;"PD";RG;Y+(RG-NG)
13030 NEXT Y
13040 PRINT #1, "PU;IW"
13050 ON SIDE GOTO 14060, 13060, 13080
13060 PRINT #1, "IN;SP2;PA4450,800"
13070 GOTO 13090
13080 PRINT #1, "IN;SP2;PA6000,800"
13090 ON SELE GOTO 13100, 13120, 13100
13100 PRINT #1, "LBDRAWDOWN RED SIDE +" + CHR$(3)
13110 ON SELE GOTO 13560, 13120, 13120
13120 ON SIDE GOTO 14060, 13130, 13150
13130 PRINT #1, "PA4450,500"
13140 GOTO 13160
13150 PRINT #1, "PA3800,500"
13160 PRINT #1, "LBDRAWGE RED SIDE " + CHR$(3)
13170 ON SIDE GOTO 14500, 13180, 13230
13180 PRINT #1, "IW";6250;400;6750;600
13190 FOR Y=0 TO 600 STEP 100
13200 PRINT #1, "PU";6750;Y;"PD";6250;Y+500
13210 NEXT Y
13220 GOTO 13270
13230 PRINT #1, "IW";5600;400;6100;600
13240 FOR Y=0 TO 600 STEP 100
13250 PRINT #1, "PU";6100;Y;"PD";5600;Y+500
13260 NEXT Y
13270 PRINT #1, "PU;IW"
13280 ON SIDE GOTO 14060, 13340, 13290
13290 PRINT #1, "IW";8400;400;8900;600
13300 FOR Y=0 TO 600 STEP 100
13310 PRINT #1, "PU";8900;Y;"PD";8400;Y+500
13320 NEXT Y
13330 PRINT #1, "PU;IW"
13340 PRINT #1, "PA900,900"
13350 PRINT #1, "DIO,1;LBRED " + CHR$(3)
13360 X=700 : Y=IR
13370 PRINT #1, "IN;PA",X,",",Y,";PD;"
13380 X=900
13390 PRINT #1, "PA",X,",",Y,";PU;"
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13400 IF NR=0 GOTO 13450
13410 X=700 : Y=JR
13420 PRINT #1, "IN;PA",X,",",Y,";PD;"
13430 X=900
13440 PRINT #1, "PA",X,",",Y,";PU;"
13450 X=850 : Y=1480+((IR-KR)/2)
13460 PRINT #1, "IN;PA",X,",",Y,";PU;"
13470 PRINT #1, "DIO,1;LBA " + CHR$(3)
13480 IF NR=0 GOTO 13560
13490 X=850 : Y=IR+((JR-IR)/2)-20
13500 PRINT #1, "IN;PA",X,",",Y,";PU;"
13510 PRINT #1, "DIO,1;LBB " + CHR$(3)
13520 IF RR=0 GOTO 13560
13530 X=850 : Y=JR+((LUR-JR)/2)
13540 PRINT #1, "IN;PA",X,",",Y,";PU;"
13550 PRINT #1, "DIO,1;LBC " + CHR$(3)
13560 IF DIR=2 GOTO 14420
13570 ON SELE GOTO 13580, 13650, 13580
13580 FOR T=1 TO NU-1
13590 YU2(T)=((YU2(T)/3)*5000)+1500
13600 ON SIDE GOTO 13620, 13610, 13620
13610 VU(T)=((VU(T)/16)*7000)+1500
13620 PRINT #1, "IN;SM+;PA",VU(T),",",YU2(T)," + CHR$(3)
13630 NEXT T
13640 ON SELE GOTO 14060, 13650, 13650
13650 X=MR : Y=KR
13660 PRINT #1, "IN;PA",X,",",Y,";PD;"
13670 Y=IR
13680 PRINT #1, "PA",X,",",Y,";PD;"
13690 X=KR
13700 PRINT #1, "PA",X,",",Y,";PD;"
13710 Y=KR
13720 PRINT #1, "PA",X,",",Y,";PU;"
13730 PRINT #1, "IW";KR;KR;MR;IR
13740 FOR Y=KR-(MR-KR) TO IR STEP 0
13750 PRINT #1, "PU";MR;Y;"PD";KR;Y+(MR-KR)
13760 NEXT Y
13770 PRINT #1, "PU;IW"
13780 IF NR=0 GOTO 14060
13790 X=MR : Y=KR
13800 PRINT #1, "PA",X,",",Y,";PD;"
13810 Y=JR
13820 PRINT #1, "PA",X,",",Y,";PD;"
13830 X=NR
13840 PRINT #1, "PA",X,",",Y,";PD;"
13850 Y=KR
13860 PRINT #1, "PA",X,",",Y,";PU;"
13870 PRINT #1, "IW";MR;KR;NR;JR
13880 FOR Y=KR-(NR-MR) TO JR STEP 0
13890 PRINT #1, "PU";NR;Y;"PD";MR;Y+(NR-MR)
13900 NEXT Y
13910 PRINT #1, "PU;IW"
13920 IF RR=0 GOTO 14060
13930 X=NR : Y=KR
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13940 PRINT #1, "PA",X,",",Y,";PD;"
13950 Y=LUR
13960 PRINT #1, "PA",X,",",Y,";PD;"
13970 X=RR
13980 PRINT #1, "PA",X,",",Y,";PD;"
13990 Y=KR
14000 PRINT #1, "PA",X,",",Y,";PU;"
14010 PRINT #1, "IW";NR;KR;RR;LUR
14020 FOR Y=KR-(RR-NR) TO LUR STEP 8
14030 PRINT #1, "PU";RR;Y;"PD";NR;Y+(RR-NR)
14040 NEXT Y
14050 PRINT #1, "PU;IW"
14060 IF DIR=2 GOTO 14500
14070 DIR=2
14080 DST=P1
14090 PRINT #1, "PU;SP0;PA1,4000"
14100 ON DIRV GOTO 14500, 10540, 10540
14110 ON SELE GOTO 14120, 14190, 14120
14120 ON SIDE GOTO 14130, 14190, 14130
14130 FOR T=1 TO ND-1
14140 VD(T)=((VD(T)/16)*7000)+1500
14150 YD1(T)=((YD1(T)/3)*5000)+1500
14160 PRINT #1, "IN;SM*;PA",VD(T),",",YD1(T)," + CHR$(3)
14170 NEXT T
14180 GOTO 12170
14190 IF CALD=2 GOTO 11810
14191 IF MG1=100 THEN MG1=2
14192 IF MG2=100 THEN MG2=2
14193 IF MR1=100 THEN MR1=2
14194 IF MR2=100 THEN MR2=2
14200 MG=((V1DG/16)*7000)+1500
14210 MR=((V1DR/16)*7000)+1500
14220 IG=((MG1/3)*5000)+1500
14230 IR=((MR1/3)*5000)+1500
14240 NG=((V2DG/16)*7000)+1500
14250 NR=((V2DR/16)*7000)+1500
14252 IF V2DG=0 THEN NG=0
14254 IF V2DR=0 THEN NR=0
14260 KG=1500
14270 KR=1500
14280 RG=((V3DG/16)*7000)+1500
14290 RR=((V3DR/16)*7000)+1500
14292 IF V3DG=0 THEN RG=0
14294 IF V3DG=0 THEN RR=0
14300 JG=((MG2/3)*5000)+1500
14310 JR=((MR2/3)*5000)+1500
14320 Q=250
14330 LUG=((PDG/3)*5000)+1500
14340 LUR=((PDR/3)*5000)+1500
14350 IF LUG)LUR THEN GOTO 14390
14360 IF LUR)=LUG THEN GOTO 14370
14370 LUG=LUR
14380 GOTO 14400
14390 LUR=LUG
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14400 DRLD=2
14410 GOTO 11810
14420 ON SELE GOTO 14430, 13640, 14430
14430 FOR T=1 TO ND-1
14440 YD2(T)=((YD2(T)/3)*5000)+1500
14450 ON SIDE GOTO 14470, 14460, 14470
14460 VD(T)=((VD(T)/16)*7000)+1500
14470 PRINT #1, "IN;SM+;PA",VD(T),",",YD2(T)," + CHR$(3)
14480 NEXT T
14490 GOTO 13640
14500 ON DIRV GOTO 14510, 14570, 14510
14510 FOR T=1 TO NU-1
14520 YU1(T)=YSC1(T)
14530 VU(T)=VUSC(T)
14540 YU2(T)=YSC2(T)
14550 NEXT T
14560 ON DIRV GOTO 14620, 14570, 14570
14570 FOR T=1 TO ND-1
14580 YD1(T)=YSC3(T)
14590 VD(T)=VDSC(T)
14600 YD2(T)=YSC4(T)
14610 NEXT T
14620 PRINT #1, "PU;SP0;PA1,4000"
14630 CLS : PRINT : PRINT : PRINT : PRINT
14640 INPUT "DO YOU WANT TO DRAW MORE GRAPHS (Yes,No)";A$
14650 IF LEFT$(A$,1) = "Y" OR LEFT$(A$,1) = "y" THEN GOTO 10200
14660 CLOSE #1
14670 GOTO 5730 : REM FROM PLOTTER
14680 REM
14690 REM RETURN TO MENU
14700 REM
14710 LOAD"ONE.SUB",R
```